REPORT

OF THE

Proceedings of the Second Entomological Meeting

Held at Pusa on the 5th to 12th February 1917

Edited by

T. BAINBRIGGE FLETCHER, R.N., F.L.S., F.E.S, F.Z.S.,

Imperial Entomologist

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PREFACE.

THE following Report of the Proceedings of the Second Entomological Meeting held at Pusa, on 5th to 12th February 1917, which has been prepared by me, is based partly on the notes prepared before the Meeting was held and partly on a running abstract made during the Meeting by Mr. G. R. Dutt, who acted as Secretary.

I am indebted to my Assistants, Messrs. C. C. Ghosh and G. R. Dutt, for assistance in going over these notes with me during the compilation of this Report.

If a Report of a technical Meeting of this kind is to be of any use to those interested, whether they were present at the Meeting or not, I am convinced that it should be as full as possible, and in the present case no pains have been spared to achieve this end, with the result that this Report is practically an abstract of our current knowledge of Indian Crop-pests, and in this aspect will, I hope, be of some assistance to non-entomological members of the Agricultural Departments and to others interested in the minimizing of damage to crops by insects.

To make it as useful as possible to non-entomologists who are not familiar with the insects mentioned herein by name, I have added references to readily accessible publications where descriptions and figures of these insects will be found. My own book, "Some South Indian Insects" (Madras Government Press; 1914) has been largely quoted in this connection because it contains figures of many common insects and also references to former publications. Since the issue of "Some South Indian Insects," a number of new coloured plates showing the life-histories of Indian Insects have been printed and issued from Pusa, and copies of most of these have been included in this Report in order to make the references as complete as possible. It is hoped, therefore, that there will be as little difficulty as possible in the recognition of the various insects referred to.

T. BAINBRIGGE FLETCHER,

Imperial Entomologist.

PUSA,

28th June, 1917.

List of Members and Visitors who attended the Entomological Meeting held at Pusa on 5th to 12th February 1917.

Members.

1. T. Bainbrigge Fletcher, R.N., F.L.S., F.E.S., F.Z.S., Imperial Entomologist.
2. A. E. Andrews, Entomologist to the Indian Tea Association.
3. R. D. Anstead, B.A., Deputy Director of Agriculture, Planting Districts of Southern India.
4. W. Robertson Brown, Agricultural Officer, North-West Frontier Province.
5. T. V. Ramakrishna Ayyar, B.A., F.E.S., F.Z.S., Acting Government Entomologist, Coimbatore.
6. C. C. Ghosh, B.A., Assistant to the Imperial Entomologist.
7. G. R. Dutt, B.A., Assistant to the Imperial Entomologist.
8. D. Nowroji, B.A., Assistant to the Imperial Entomologist.
9. Y. Ramachandra Rao, M.A., F.E.S., Assistant to the Imperial Entomologist on Special duty in connection with Lantana insects.
10. H. L. Dutt, M.S.A. (Cornell), Assistant Professor of Entomology, Sabour.
11. Madan Mohan Lal, B.Sc., Assistant Professor of Entomology, Lyallpur.
12. K. Kunhi Kannan, M.A., Senior Assistant Entomologist, Mysore.
13. K. D. Shroff, B.A., Entomological Assistant, Burma.
14. J. L. Khare, L.Ag., Lecturer in Entomology, Nagpur.
15. Ratiram Khamparia, Entomological Assistant, Central Provinces.
16. T. N. Jhaveri, L.Ag., Entomological Assistant, Bombay.
17. P. C. Sen, Entomological Collector, Bengal.
18. S. R. Gupta, Entomological Assistant, Assam.
19. E. S. David, Entomological Assistant, United Provinces.
20. Ahmad Mujtaba, Head Fieldman, Entomological Section, Pusa.
21. Dwarka Prasad Singh, Fieldman, Entomological Section, Pusa.
22. G. D. Ojha, Fieldman, Entomological Section, Pusa.

23. Ram Saran, Fieldman, Entomological Section, Pusa.
24. Harihar Prasad, Fieldman, Entomological Section, Pusa.
25. Harchand Singh, L.Ag., Post-graduate student, Entomological Section, Pusa.

Visitors.

1. Mr. J. Mackenna, M.A., I.C.S., Agricultural Adviser to the Government of India.
2. Dr. L. C. Coleman, M.A., Ph.D., Director of Agriculture, Mysore State.

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ENTOMOLOGICAL MEETING: PUSA, FEBRUARY 1917.

Fourth Row (Standing): Messrs. Khare, Ghosh, Jhaveri, H. P. Pande, A. Razaq, Harchand Singh, S. N. Lal, Nowroji, Ram Saran.
Third Row (Standing): Messrs. Shroff, H. L. Dutt, M. M. Lal, G. R. Dutt, Mujtaba, David.

PROCEEDINGS

OF THE

Second Entomological Meeting held at Pusa on 5th to 12th February 1917.

The first session of the Second Entomological Meeting was held at Pusa on the afternoon of 5th February 1917, the proceedings on the first day being held in combination with the Mycological Meeting which had also assembled at Pusa on the same date.

The combined Entomological and Mycological Conference was opened by Mr. J. Mackenna, M.A., I.C.S., Agricultural Adviser to the Government of India, who in his introductory speech said :—

" DR. BUTLER, MR. FLETCHER and Gentlemen,

"I desire to extend to you a hearty welcome to Pusa. In the first place I have much pleasure in reading the following letter which I have just received from the Hon'ble Sir Claude Hill, Member in Charge of the Department of Revenue and Agriculture :—

'I am sorry that I shall not be able to be present at your Sectional Meeting of mycologists and entomologists to be held at Pusa, but it is quite impossible for me to get away from Delhi at the present time. This meeting is the first of the sectional meetings which we hope to develop with your assistance and it will, I hope and feel sure, be the precursor of many future valuable meetings of other branches, also of the Department. The ordinary Board meetings, which are held every other year—though we hope perhaps to organize more frequent meetings—require supplementing by sectional meetings such as the one you are about to hold, and I am not sure that these sectional meetings are not likely to prove even more valuable in their way than the general Board meetings. At all events, I feel quite sure that the mycologists and entomologists, who will meet you at Pusa, are inaugurating a system of very great value. Just as is the case in every other branch of our work, we are, of course, under-staffed, but, to a very large extent, I think that the shortage of men is made up by the zeal of the individual workers in these and other scientific branches, and it would have been a very great pleasure to me if I could have been present to inaugurate this pioneer meeting. Will you please express to the members attending

the meeting my personal regret at not having the pleasure of seeing them and my best wishes for the success of their deliberations ?'

"There is a general feeling that in addition to the ordinary meetings of the Board of Agriculture, which are held every second year, it will be of the greatest advantage if workers on particular subjects can have more frequent opportunities of conferring with each other. The Government of India propose to adopt the policy of sectional meetings in years in which a full meeting of the Board of Agriculture is not held. As you are aware, Mr. Bainbrigge Fletcher two years ago held a meeting of entomological workers and as the working out of the details of sectional meetings will take some time, it was felt that the wishes of the Government of India could best be given effect to by a development of this idea and by calling meetings of two branches which, though of great importance, are not particularly strongly manned.

"It seemed desirable that this handful of scattered workers should be called together to discuss their difficulties and co-ordinate their work.

"In addition to some questions of general policy which will be discussed by the two sections sitting together, Dr. Butler and Mr. Fletcher will arrange for the discussion of subjects of a technical nature connected peculiarly with their own branches of science. I am very glad to see such a representative gathering of mycologists and entomologists. I trust that you will have a very pleasant time at Pusa and that the results of your deliberations will not only be of great advantage to yourselves, but of very great assistance to the Government of India. Mycology and entomology are represented in India by a mere handful of workers, but I think I may safely say, that proportionate to their numbers their achievement has been great. In both branches you are battling against enormous difficulties and innumerable pests. The labourers in these fields of science are indeed few, but I think you have every cause to congratulate yourselves on the impression which has already been made on the suppression and control of fungoid and insect pests. I trust you will have very successful meetings and that as a result you will return to your respective provinces equipped with new ideas with a new stimulus to increased endeavour."

Dr. Butler and Mr. Fletcher explained the programme of work for the meetings and the sections then adjourned to take up special subjects.

A combined Entomological and Mycological Committee met on the afternoon of 8th February, with Mr. Mackenna in the chair, to consider the Madras Agricultural Pests and Diseases Act.

On the afternoon of 9th February a combined meeting of the Entomologists and Mycologists was held to consider the Rome Phytopathological Conference.

Dr. Butler explained that he had hoped to have copies of a Memoir he had written on the subject, available for members, but the press had not been able to deliver them in time. The subject was one of considerable interest, though any practical outcome from the Conference would necessarily be postponed until after the war. Some 30 States and Colonies sent their phytopathological and diplomatic representatives to Rome early in 1914 and an International Convention for the control of the inter-state circulation of certain classes of nursery and horticultural stock was drawn up and signed by all the delegates. The States concerned had for the most part not ratified the Convention owing to the war, but the matter was sure to be taken up again and meanwhile we had an opportunity of making up our minds on the subject, after examining how the proposed Convention would affect India. Adhering States were required to set up a Government Phytopathological Service for the inspection of nurseries engaged in the export of horticultural produce and at the same time pledged themselves not to admit within their frontiers any such produce unless it carried certificates of inspection by the officers of the Phytopathological Service of the country of origin. These certificates would state that the produce was in a satisfactory sanitary condition and was free from any disease or pest mentioned in a list which each adhering country would draw up. No country was prevented from making any other regulations, but he assumed that no country could refuse entry to a properly certified consignment. There were various restrictions as to the pests that a country could list and others securing the liberty of action of licensed scientific institutions. Imports from non-adhering countries must cease unless they carried similar official certificates. He considered this a great step in the right direction and thought that the Convention might subsequently be extended to cover field and planters' crops, which were at present outside its scope.

Mr. Fletcher pointed out that the Convention would be no safeguard against the introduction of many insect pests which could easily escape detection by the Inspector. Fumigation on entry was the only remedy in these cases.

Dr. Butler said that there was nothing in the Convention to prevent fumigation after entry.

Mr. Fletcher then pointed out that the lists of insects to be kept out would be difficult to prepare for any particular crop, as a pest of fruit trees might come in on ornamental plants or *vice versâ*. Also a pest that did little harm in one country might be destructive to the same plant in another country, as was the case with cotton boll-worm.

Dr. Butler considered that the clause in the Convention requiring that any pest listed should be very harmful was a weak point. Several of the clauses required improving, but he thought that what would happen was that, in view of the criticisms to which the Convention was being subjected in several countries, a new one would be signed after the war. He felt sure that the matter would not be altogether dropped and that countries that did not join in the movement would find themselves at a disadvantage.

Mr. Anstead inquired how the present Indian Destructive Insects and Pests Act would be affected.

Dr. Butler said that so far as he could see the Convention would not affect our Act, which would be supplementary to it. It would simply make it easier for us to get certificates under our Act, since every adhering country would be obliged to maintain an efficient inspecting staff.

A discussion then took place regarding the extent and nature of the export of horticultural produce from nurseries in India, and it was elicited that the export was probably small, both in quantity and value, but that exact returns were not available. It was suggested that such returns should be obtained if possible. Members also undertook to make local inquiries regarding the nursery trade in their respective areas so as to be in a position to advise on the working of the Convention if India adhered. It was also suggested that a survey of the insect and fungus pests of plants should be kept up, so that the lists required under the Convention could be prepared if occasion arose.

The sessions of the Second Entomological Meeting were held on 6th to 12th February inclusive and a *verbatim* Report of the Proceedings is given hereafter.

CHAIRMAN'S OPENING ADDRESS.

Gentlemen—Before proceeding to the consideration of the subjects to be discussed by this Entomological Meeting, I should like to say a few words. I did not address you yesterday because yesterday's meeting was a combined one with the Mycologists, and therefore it seemed better to reserve my address for the Entomological Meeting only.

In the first place, I should like to extend a word of welcome, on behalf of the Entomological Staff at Pusa, to those amongst you who have come here to attend this Meeting as delegates and visitors from the Agricultural Departments in the Provinces and Native States and from other Services equally interested in the progress of entomological work in India. The fact of your meeting together here will, I hope, be

of equal advantage both to us at Pusa and to you. We on our part will gladly place at your disposal our experience with regard to insect pests and doubtless you on your part will be able to supplement our information with additional facts regarding the occurrence of such pests and their control in your particular areas, with benefit not only to us at Pusa but to your other co-workers in other Provinces. There is no need to say more on this subject further than to remind you of the couplet which you will see every month on the front cover of each issue of the "Entomologist":—

"By mutual confidence and mutual aid
Great deeds are done and great discoveries made."

Although we may not be able to lay claim to "great deeds or great discoveries", I hope that that will not deter us from mutual confidence and mutual aid.

A Meeting of this kind is quite informal and is designed to keep touch between the various workers in order that each may know what the others are doing and may contribute his own observations and experiences to the common stock and perhaps learn a little from the experiences of others.

It is now just two years since our last Entomological Meeting, which was attended by representatives from Madras, Bombay, the Central Provinces, Bihar and Orissa, the United Provinces, Assam, Baroda and Travancore. Burma, Bengal and the Punjab, which were not represented at the last Meeting, have sent their Entomological Staffs to this one and they will, I hope, fill gaps in our knowledge. Of the others, who were present here two years ago, Mr. Howlett has been absent on leave since July 1915. Mr. Ballard went to England on sick leave in August 1915 and joined the Army as an Artillery Officer; I understand that he proceeded to France and is now in England again. Mr. Beeson has been employed on Fly Work in Mesopotamia and is still there. If he had been in India, he would probably have attended our Meeting this year also, but I hope that the Forest Department will be represented by Mr. Champion whose attendance has been requested by the Government of India in order that he may represent the Forest Department in the discussion, which we shall have later on in the week with the Mycologists, regarding legislative measures for the control of plant pests and diseases. [*Mr. Champion, however, did not come to Pusa.*] Mr. Woodhouse, who attended our last Meeting and gave us a detailed and most interesting account of the *Agrotis* campaign at Mokameh, has since joined the Indian Army Reserve of Officers; he proceeded to France but has since returned to India and by the last account I have heard was at Secunderabad. At our last Meeting also the Indian Museum

was represented by Mr. Gravely, who, as most of you know, is the Assistant Superintendent in charge of the Entomological Section of the Museum; I had looked forward to seeing Mr. Gravely amongst us again this year, but unfortunately he is unable to attend, as he is away on an extended tour in the Southern Shan States. On the other hand, Mr. Andrews, the Entomologist to the Indian Tea Association, who attended two years ago, is here again today and will doubtless have some interesting things to tell us about *Helopeltis* and other Tea Pests; Mr. Anstead, the Deputy Director of Agriculture in the Planting Districts of Southern India, has also come to give us the benefit of his experience with pests of tea, coffee, and rubber in Southern India; Dr. Coleman, the Director of Agriculture in Mysore, is also here and will doubtless be able to attend some of our Meetings dealing with the crops in which he is most interested; and finally, Mr. Robertson Brown, the Agricultural Officer at Peshawar, though not present to-day, will be here later on in the week and will doubtless tell us something about Fruit Pests and other noxious insects of the North-West Frontier Province.

At our last Meeting I made a few remarks which perhaps I may repeat, as some of you now present were not at the last Meeting two years ago. I said then:—

> "The relations of Pusa with the Provinces are peculiar and in many ways unsatisfactory, but, so far as Entomology is concerned, there is a distinct *raison d'être* for a Central Institute which will occupy itself with such items as identification of insects, working out of lifehistories (with which is included the preparation, printing and distribution of figures and coloured plates and lantern slides), the centralization of records both in the way of specimens and literature, and the publication of collected results based on work not only at Pusa but in the Provinces and also outside of India. This leaves the Provinces free to give their time to teaching, and to trial and demonstration of control methods. This is an ideal scarcely realized in practice. But as a matter of practice I would particularly appeal to all the Entomological Assistants to keep in touch with Pusa and to send in specimens of all their pests so that there may be as complete a record as possible at the Central Institute. Specimens will be identified as far as possible and duplicates returned after naming, but we would particularly ask for a fair series of specimens in good condition. Sometimes specimens are sent in in very bad condition, and I lately received for naming a single specimen of a moth (or, rather, the remains of

what had once been a moth) with its head off, its body gone altogether, its legs broken, and the wings broken, rubbed and nearly scaleless. Well, a thing of that sort is of very little use to anyone. With a little care in preparation and packing of specimens it is just as easy to send in good material, which can be examined, as material in too poor condition for proper examination.........."

Now, those were some of the remarks I made two years ago, and I repeat them now partly because some of you were not here two years ago and partly because some, who were here then, have not perhaps paid as much heed as they might to what I said then. Unless you Provincial workers are prepared to work together, with us and with one another, your work is not attaining its proper value nor can we give you the assistance we might give and which we on our part are always willing to give.

There are one or two points about your work on which I wish to speak to you. In the first place, exact records of occurrence of insects, whether found as pests or otherwise, are essential. In going over our collection to obtain information, this point is very noticeable, especially in the case of the older specimens. Vague references, such as " on cotton ", should be avoided. Such references are generally valueless and often misleading. It is just as easy to give an exact record. To label a specimen " on cotton " means anything or nothing. It may be a serious pest or a mere casual visitor resting by chance on a cotton-leaf. But if you are sufficiently careful to label your specimen—" larva rolling cotton leaf ", " larva boring cotton stem ", "adult eating cotton flower ", or whatever the facts were—your specimen with its exact record becomes of some value.

Another thing to avoid as far as possible is the use of local names of foodplants. It is generally possible for you to ascertain and use the correct botanical names of foodplants, and this is especially necessary in the case of weeds and wild plants which form alternative foodplants of pests. You must remember that local vernacular names are usually current only in very limited areas, outside of which they are not understood at all, and furthermore that they are often applied in such a vague way that it is impossible to be certain what is intended even in districts where they are current. Even in the case of many major crops their common names, both English and vernacular, are often widely different in different localities. It is better also to avoid as far as possible the use of general terms, such as " millets ".

It is very important to secure exact records of the occurrence of common insects. You should endeavour to dismiss from your minds

the idea that, because an insect is common, we know all about it and there is no need to keep exact notes of its occurrence. The facts are far otherwise. There is no insect, however common, of which we really know anything worth knowing, and it is by the accumulation of innumerable records of information, each doubtless small and unimportant but each exact and complete in itself, that we may hope to attain to a more complete knowledge. I may mention as examples the cases of *Agrotis ypsilon* and *Pieris brassicæ.*

As you all know, a good deal of work has been done with *Agrotis ypsilon* during the last few years, chiefly in connection with its occurrence as a pest on the *tal* lands around Mokameh. These lands are flooded to a depth of several feet in the Rains and, as the river drops and these lands are left exposed, they are placed under cultivation with mixed winter crops which are attacked extensively by *Agrotis ypsilon.* I am not going to speak now of the control-measures which have been adopted in this case—we shall come to that later on during this Meeting—but of the occurrence of the *Agrotis* in this area and of the curious gap at present existing in regard to our knowledge of its lifehistory throughout the year. As I said just now, these lands are flooded throughout the Rains to a depth of several feet and can only be cultivated and crops sown after the water has dropped; but, as soon as these crops begin to spring up, they are attacked by *Agrotis* larvæ, and it is evident that the eggs are laid by the parent moths on the newly-exposed muddy lands. But where do these moths come from? They go on breeding on the Mokameh *tal* in increasing numbers from about the end of August or beginning of September—the date necessarily varies with the flooding of the Ganges—until December or January, when the numbers begin to drop, owing probably to the effects of the cold weather and parasitic attack, but the insect is found breeding until about the end of March. About the end of March or beginning of April we usually find a large number of moths and then these disappear and no trace of the insect can be found until about the end of August, when moths suddenly appear again to lay eggs on the newly exposed *tal* lands. What becomes of the insect during the period April-August under natural conditions? At Pusa we have been able to keep continuous broods going during this period, but the insects were obviously under unnatural conditions and did not seem at all happy, and it seems very unlikely that it passes through these months in an active state under natural conditions. Careful search in and around the affected *tal* lands has completely failed to discover *Agrotis* in any stage at this time of year, and at present we can only suppose—it is, mark you, merely a supposition and not an ascertained fact—that the parent moths of the earliest broods are migrants

from some Hill district in which the insect breeds during the period between April and August.

If you come to Pusa during the first half of February in any year and look around the cabbage-plots you will see numbers of *Pieris brassicæ* flying around and ovipositing on the plants. If you had come here a fortnight earlier, in the second half of January, you might have looked for a long time without seeing a trace of this butterfly in any stage. At Pusa, generally on or about 1st February in every year, the butterflies suddenly appear in some numbers, and it is noticeable that most of them are worn examples and a large proportion is composed of females. These oviposit and two or three broods result until about the beginning of April, when the insect again disappears completely until the next year. We have been quite unsuccessful in carrying it on beyond this, and, so far as we know, this insect is not found at Pusa in any stage between May and January. Whence then do the first butterflies appear about 1st February ? Once again, from the facts of the case and from records of known migration-flights of *Pieris brassicæ* in Europe, we are driven to accept the theory—remember, it is only an unproved theory in this case also—of migration.

Here we have the cases of two common insects, regarding whose lifehistories, in Bihar at all events, we must confess our ignorance in spite of various attempts to bridge the gaps in our knowledge. If we had exact records, with exact dates, of the appearance and disappearance of these two species in adjacent or other areas in India, I venture to think that such records might throw some light on the subject and would at least yield something in proof or disproof of our present theories of migration from other districts—theories which fit the facts so far as we know them at present but which, I repeat, are as yet mere suppositions.

With further reference to such points, I am now going to read two short extracts from the Annual Reports of the Pusa Institute for the last two years, that is, since our last Meeting. In the Report for 1914-15, I wrote :—

> " A point, which has been observed with regard to some common insects (*Laspeyresia, Chilo, Chloridea*) reared for observation of exact cycles of their lifehistory, is that out of the same batch of larvæ, feeding and commencing to hibernate at the same time, some hibernate and emerge as adults ", that is to say, they hibernate and emerge as adults as soon as the weather begins to warm up after the cold season, " whilst others hibernate during the cold weather, then aestivate during the hot, dry season and emerge at irregular intervals thereafter as late as July or August. From the practical

point of view of control this is of some importance, as measures taken on the first appearance of the insects after hibernation may be rendered abortive, or will at least require to be supplemented, in view of these late emergences. An observation of this kind, apparently trivial in itself, emphasizes the fact that an intimate knowledge of the habits of the insects concerned must be the first step towards their control."

This seems to me an excellent illustration of the necessity for exact observations and records of even the commonest insects, for, as I have pointed out in the extract which I have just read to you, any successful measures of control of such insects must be based on a very exact knowledge of their lifehistories.

An interesting confirmation of these remarks has lately come to hand in a voluminous report recently published by Mr. Willcocks on the Insect Pests of the Cotton Plant in Egypt, of which Part I deals with the Pink Bollworm (*Gelechia gossypiella*) which, as you all know, occurs commonly throughout India also. In November 1913 Willcocks took fifty thousand larvæ of *G. gossypiella* and placed them in a large cage and observed the emergence of the resulting moths; he found that they emerged right up to 28th August 1915, the largest numbers of emergences being in November 1913—January 1914, July-October 1914, and April-August 1915, this last lot being much smaller in number than the two previous lots. Now, an experiment of that sort throws a great deal of light on the question of control; for even if no cotton had been available for the whole of the year 1914, cotton grown in 1915 might still have been attacked by caterpillars from parents which had fed up two years before. As regards the application of these results to India, we are quite in the dark as to whether the same conditions hold. Taking the case of *Gelechia gossypiella*, we do not know, as a matter of fact, how long a period may emerge between the times when the larvæ are full-fed and the emergence of the moths. Yet experiments on these lines—the simple collection of full-fed caterpillars and breeding out of the moths—are open to each one of you. But it is little use to take a dozen or so caterpillars and expect to get much in the way of results. You must deal with large numbers to avoid experimental errors and get good results.

In the next year's Report for 1915-16, I wrote:—

"Large numbers of Fruit-flies were reared out to discover to what extent they are checked by parasites, but it was found that the proportion of parasites is extremely low. The only Fruit-fly which is parasitized to any appreciable extent

> is *Carpomyia vesuviana*, whose larvæ feed in fruits of *Zizyphus jujuba*. About 800 pupæ of this fly were sent to Italy, to endeavour to introduce the parasite there, but owing to postal delays they failed to reach their destination alive."

Now, with reference to that there are two things that I want to say to you now. We shall come, later on during this Meeting, to the subject of Fruit-flies of various species and their control, but it seems to me that one very important possible control-measure, which we require to know a great deal more about in India, lies in the direction of the employment of natural parasites of these Flies. As some of you probably know, the matter of Fruit-flies has proved sufficiently important in some parts of the World for the sending out of special investigators to discover and introduce such parasites, and since our last Meeting the United States Department of Agriculture has sent one of their Experts, Mr. Fullaway, to India especially to collect and take to Honolulu living examples of parasites of our common Indian pumpkin-feeding Fruit-fly, *Chætodacus cucurbitæ*. Mr. Fullaway visited Southern India at the end of 1915 and was successful in finding such parasites and in transporting them alive, firstly to Manila and afterwards to Hawaii. A successful attempt of this kind should stimulate us in India to repeat it for ourselves. There is probably no Province or district in India in which *Chætodacus cucurbitæ* does not occur, and there are few in which it does not do serious damage. It is quite within the capacity of each one of you, Provincial workers, to get damaged cucurbitaceous fruits and to collect the pupæ of the flies from them and to see what parasites occur in each area ; or you can send the affected fruit in to Pusa and we will do the breeding part of it. In this way it seems quite possible that we may find a parasite or parasites, effective in some districts but absent from others into which we can introduce them to secure a natural control of this Fruit-fly. This is a matter in which you can all help for the common good, and I ask you to do so.

From the above extract you will also have seen that we have been sending pupæ of *Carpomyia vesuviana* to Italy, to Professor Silvestri at the School of Agriculture at Portici, to try and introduce a small Braconid parasite (*Biosteres carpomyiæ*, Silv.) which is common at Pusa. Here again you can all help by collecting pupæ of *Carpomyia* and by sending them either to Pusa or, better still, direct to Professor Silvestri.

It is not, however, only with regard to the occurrence of insects that I desire to impress upon you the desirability of exactitude of records.

It is also in regard to the insects themselves and their identification. Here again, exactitude is essential and must form the basis not only of progress but of all control measures. When we come to deal with the subject of Termites as pests of Wheat, I shall have more to say on this point. In the meanwhile I shall preach you a small sermon with *Eucosma* (*Eucelis*) *critica* as a text. During the past year I have overhauled and put into order our collection of Micro-lepidoptera and in going over it had occasion to examine the series of specimens standing under the name *Eucelis critica.* It was composed of three old specimens in bad condition. The first proved to be an *Anarsia*, which, as you probably know, does not even belong to the Family Eucosmidæ but to the Gelechiadæ ; the second was a mouldy mass which at first sight I took to be a cocoon but which, by the remains of a leg sticking out of the mould, had apparently once been a moth, and was now quite indeterminable ; the third was an ordinary example of *Eucosma melanaula*. All these specimens had been placed in the collection under the name *Eucosma* (*Eucelis*) *critica*, simply because every greyish moth found spinning up *Cajanus* shoots was lumped together as *E. critica.* That may be a method of convenience, but it does not make for accuracy and it makes it impossible to be sure, in the absence of recognizable specimens, whether any of our older records of the occurrence of *Eucosma critica* really refer to that species or not. I may perhaps add a moral to this story by saying that even the elect are sometimes deceived, and that, owing to its variable appearance, this very species (*Eucosma critica*) has been described under three names by the same author, who is one of the best of our systematists.

Such things illustrate the fact that we progress towards a better knowledge, provided that we are not satisfied with sticking in a groove. Our present knowledge of insects is infinitesimal. There is not a single Indian insect of which we can say that we know all about it. There are boundless opportunities in India—and it is open to each one of you to take them—for observation and study of the lifehistories, occurrence, food, habits, enemies, and all aspects of the economy of even the commonest insects. Every one has its own peculiarities and it is very unsafe to generalize from particular instances. I can give you an example of that from some observations which I happened to make last year. Most of you have probably seen some of Fabre's books and read, amongst others, his account of the Hunting Wasps. You will remember that Fabre, as the results of numerous experiments, came to the conclusion that the instincts of these wasps were immutably fixed and that they necessarily carried out every detail of nest building and storage of food for their young as a sort of fixed routine, being

compelled to perform every action in a fixed order; so that, if this routine was upset artificially, the insect was unable to cope with the new conditions. In Fabre's "Insect Life" there is a whole chapter entitled "the ignorance of instinct" and in reference to *Ammophila* he says "the creature obeys, impelled by instinct, without reasoning on what it does". Doubtless Fabre's observations were quite accurate so far as concerns the species which he had under observation; the validity of his conclusions is another matter. But numerous writers have quoted Fabre's observations and have applied them generally and stated in effect that the actions of insects such as these Hunting Wasps are governed entirely by fixed instincts and not at all by intelligent reasoning. Well, with regard to that aspect of the matter, I can only tell you briefly a few facts which I noted last year. Last May, when I was at Peshawar, in a room of the bungalow in which I was breeding *Dacus oleæ* and other insects, a mud-cell-building *Eumenes* of the species common in that part of India—*Eumenes dimidiatipennis*, to be exact—was busily engaged in building a cluster of mud-cells on the mantelpiece and storing them with caterpillars. I watched its operations and, I am afraid, interfered with them considerably. When I first saw it, there was one mud-cell stored and closed up and a second cell started. I opened up the first (completed) cell and removed the stored caterpillars. According to the theory of fixed instincts, the wasp ought to have paid no further attention to the first cell but ought to have gone on building the second one in a purely mechanical routine way. But what actually happened was that the wasp temporarily abandoned the second cell, came back to the first one, mended it where it was broken open, went and caught more caterpillars, re-stored the first cell and closed it up before going on with its work on the second cell. On another occasion, after this same wasp had stored and closed up a cell and was engaged in bringing mud to start a new cell, I placed on the outside of the closed cell a stung caterpillar removed from another cell. Presently the wasp returned with its load of mud, saw the caterpillar and examined it and evidently thought the matter out; apparently it came to the conclusion that the caterpillar must have escaped somehow from the closed cell, so it proceeded to reopen the cell, stowed the caterpillar away in it, re-closed the cell, and then went on with its work on the foundations of the new cell. Here again—I may be wrong in my conclusions, but you can draw your own conclusions; I give you the facts which I observed—it seemed to me that the wasp, far from being tied down to a mere routine inflexibly laid down by instinct, showed a distinctly intelligent appreciation of a novel situation and modified its procedure accordingly.

There are two morals to be drawn from this story. In the first place, observations of this sort can be made by any one of you. They are full of interest and a knowledge of the behaviour of insects under various conditions helps us to realize their ways better, and a realization of habits may often form the foundation of a successful means of control in cases when they are doing damage. In the second place, you should try to remember that Biology is not an exact Science like Mathematics. When you are dealing with living animals or plants you cannot always employ general rules, because the individuals may tend to modify their actions under different conditions. In dealing with insects it comes to this, that every different species requires separate study.

This brings us to the subject of text-books. There is rather a tendency in India, I am afraid, to demand on every subject a text-book which is looked on as the be-all and end-all of knowledge on each subject. Anything not in the text-book is incorrect or need not be considered, and what the text-book says must be true. That may be all very well in the case of exact Sciences, but it is distinctly not the case in inexact Sciences such as Biology. In the case of a subject such as Entomology which deals with an almost unrealizable number of separate organisms differing widely amongst themselves in structure and habits, it is absolutely impossible for any general text-book to meet all the facts of the case. Our knowledge is continually expanding and progressing year by year, and statements made to-day may be challenged to-morrow. But accurate observations will always endure and be useful. I want to impress upon you, therefore, the necessity for checking for yourselves, so far as you can, any previous statements or observations, whether your own or anybody else's. Try always to make your information more complete. As I have already told you, all our information on Indian Insects is at present sadly incomplete. In the preface to *South Indian Insects* I particularly said that it was not to be looked on as a text-book because I realized, as I stated, that it was incomplete. All our records are incomplete and we must largely rely on you, Provincial workers, to make them more complete than they are at present. At present we cannot even attempt to prepare a list of Crop-pests which will be final and not subject to numerous additions and alterations within a very short period of time.

Whilst on the subject of exact observations of Indian Insects, I should like to say a few words about the publication of short notes of this kind. If you make new observations on insects you should take some steps to make them available to other workers. With this object in view I have initiated a system of publication of such Short Notes

collected, one hundred at a time, to form a Bulletin of the Agricultural Department. One such Bulletin has been published and I have at present about half the material towards a second one, and others will be issued as material accumulates. I think that you will find this a convenient system for recording any small observations which you may make on the occurrence, habits or control of any Indian Insects. Centralized records of this sort are not only more easily available to other workers but benefit by editing. I do not of course set up to have an all-round knowledge and ability to check and criticize every observation you may make, but I can often help by adding parallel observations from literature or other records in our collection or files.

In response to requests from some Provinces, I have prepared and had printed a list of our coloured plates of Indian Insects. Of course, there have been some additions since that went to press, as new plates are continually being done as material is available. The new, unprinted plates are placed on the table so that you may all have an opportunity of seeing them. In going over the list of Crop-pests I should be glad if Provincial Delegates would state the fact if they consider that any figures or plates are required of particular insects of importance in their Provinces.

I will also arrange to give an exhibition of Lantern Slides of Indian Insects on one of the evenings of the week during which you will be here, so that you may be able to see the new slides and be in a position to know which will be of use to you. [*This was done.*]

One result of the War has been the difficulty of obtaining supplies at present. Last month I went down to Calcutta and interviewed all the Firms importing Spraying Machinery and have got together here a collection of machines representing the various types that are obtainable now-a-days. These are in the next room together with samples of various insecticides. You will thus have an opportunity of seeing for yourselves what is obtainable now and of knowing where to obtain it and details of price, etc.

So far as more purely entomological apparatus is concerned I have been in correspondence with Messrs. Lawrence & Mayo about the manufacture and supply of improved types of nets and store-boxes, and I hope that these will be available shortly. As regards the present supply of other apparatus, such as pins and glass-ware, we will gladly give you any information we can on the subject.

The Laboratory, with the Collections and Records, the Insectary and Silk-house will of course be open for your inspection during the

time you are here, and I hope that you will all take the opportunity of seeing anything that you want to see.

There is one other subject on which I will say a few words, and that is in regard to the *Lantana* investigation which has been taken up. You all, I suppose, know what *Lantana* is ? [*Some of the Provincial Delegates stated that they did not know Lantana, and fresh plants were consequently obtained and exhibited at a subsequent meeting.*] Some of you at least know it and may know how it has gained a footing and spread in many areas in India and Burma until it has become a serious nuisance. You may also be aware of the methods by which attempts have been made to control it in other countries, notably in Hawaii, by the introduction of various insects to check its capacity for fruiting. It has been proposed that similar steps should be taken in India and, as a preliminary step, Mr. Ramachandra Rao, of the Madras Agricultural Department, has been placed on special deputation to study *Lantana* and particularly to try and find out whether we already have in India or Burma any insect which is capable of checking its spread and which may be safely used for this purpose. Mr. Ramachandra Rao has come to Pusa to attend this Meeting and later on will tell us the results of his preliminary investigations. Next month he will start work in Coorg and will probably remain there until the monsoon breaks about June, or as soon thereafter as he has finished any work which he may have in hand then. After that, during this year and next year, he will visit other localities where *Lantana* occurs, in his search for insect checks on this plant. No definite programme can be arranged yet, but, whilst you are all together here, I want you to take the opportunity of talking the matter over with Mr. Ramachandra Rao and letting him know, as far as you can, the areas in your several Provinces invaded by *Lantana* and the best time of year to visit such areas, with any details of accommodation or conveniences for such work and so on. This information will perhaps give us a basis to work on when we come to make out a more definite programme later on, when we see how the work is shaping.

We come now to the main business before this Meeting, which is the discussion of mutual experiences with regard to the occurrence and control of insect pests, principally crop-pests. I am afraid that I cannot give you any exact definition of what is a pest or what is a crop. One of the most striking points brought out by the last Entomological Meeting was the great difference of view regarding the right of many insects to be regarded as crop-pests. In numerous cases, an insect, which was regarded in some Provinces as of no account at all, was claimed by others as a serious pest. So that we shall have to guide ourselves

by common-sense, combined perhaps with a little prescience. By prescience I mean this—that in some cases we know of insects which are capable of becoming, or which we consider likely to become, pests although they may never yet have been noted to do damage in India, and we shall err on the safe side by including them, for the present at any rate, in our Pest List. I will give you two examples of what I mean. In writing my book on *South Indian Insects* in 1913 I included the small Jassid bug, *Nephotettix bipunctatus*, as a paddy pest, although it had never actually been observed up to that time to do damage to paddy, because, as I said, it "sometimes appears in such enormous numbers that it may be assumed to be at least a minor pest." This statement proved rather prophetic as within two years this insect appeared as a serious pest of paddy in the Central Provinces.

The second example is *Prays citri*, to whose occurrence in India I called attention, in the Bulletin of Short Notes issued last year, as soon as it had been found to occur in Southern India, in North Coorg. Within the last week I have received from Mr. Meyrick a list of identifications of specimens sent to him and I find amongst them a specimen of *Prays citri* taken here at Pusa last March. It is probable that this species is widely distributed and common and that it does damage to *Citrus* flowers in orange-growing districts and therefore I consider it as an example of an insect which should be placed on our List of Pests even though we do not yet actually know that it does damage in India. It is a potential pest and requires surveillance as such.

At our last Meeting we went over the Crop-pests in systematic order and considered each insect separately. For this Meeting I have prepared a list of crops, with the pests of each, and I propose that we consider these, crop by crop. I will first read over our list and give you such information as we have on each subject and then you can add any information that you can.

But, before we start with the lists of crops and pests, I will ask if any of you have any particular subjects to bring before this Meeting. [*To this question there was no reply.*]

Then we will proceed with the business before the Meeting. It would really be better to take these lists of crops in regular order, starting with paddy as the most important crop in India, and following on with other cereals, sugarcane and so on. But, as we have the benefit to-day of the presence amongst us, besides Mr. Andrews, of Mr. Anstead and Dr. Coleman, and as they are interested largely in Hill Crops and also wish to attend some of the Mycological Meetings on other days of this week, I propose to start to-day with the Hill crops, and we will first of all consider the insect pests of tea.

TEA (*Camellia theifera*).

We will start with the insects attacking the leaves of the tea-bush. Our list of tea-pests is very incomplete because we at Pusa have little opportunity of seeing them, but the following are known as more or less serious pests of tea :—

Stauropus alternus.
Biston suppressaria.
Parasa lepida.
Clania of various species.
Heterusia of various species.
Homona coffearia.
Laspeyresia leucostoma.
Contheyla rotunda.
Olene mendosa.
Andraca bipunctata.
Phytoscaphus dissimilis.
Corigetus bidentulus.

Taking these in detail :—

Stauropus alternus is occasionally found on tea and some years ago occurred as a sporadic serious pest of tea in the Kalutara District in Ceylon. It must therefore be regarded as a potential pest of tea in India It is by no means confined to tea, the larva feeding on *Cajanus indicus*, rose, tamarind and various other plants.

It is found all over North-East India but no general outbreak has occurred so far.

Mr. Andrews, will you tell us something about *Biston suppressaria* in North-East India ?

This pest is worst all along the North bank of the Brahmaputra. It turns up every year but is sporadically serious in Sibsagar and Jorhat. There are three broods in a year, the second being the worst. As regards remedial measures, the pupæ are found underground around the bushes and these are dug out by coolies when the soil is opened up around the bushes, as is now done on most gardens in North-East India every cold weather. Wherever this is done, the pest is reduced in numbers and the damage is gradually lessened. In one place the pest was bad in the first brood, and it was suggested to hoe around the bushes and collect all the pupæ as soon as the caterpillars of the first brood had left the bushes; this was done and, as a result of this measure, the second brood was not so serious. This method has the advantage of being a cultural practice and can be practised annually.

That seems a satisfactory means of control as it can be combined with ordinary methods of cultivation. Regarding the occurrence of

Biston in Southern India this insect was included in my book as having been once reported as damaging tea. Have you had any further experience with it, Mr. Anstead?

It has not occurred again lately and I have nothing more to add. It does not seem to be common in Southern India as a rule. **Mr. Anstead.**

We will go on to *Parasa lepida.* This insect, as you know, is a very general feeder and occasionally occurs on tea in some numbers, but it does not seem to be anywhere a specific pest of tea. **Mr. Fletcher.**

We will go on to *Clania.* There are numerous species, all closely allied and quite similar as regards the damage they do. They appear to be bad pests in the Northern India Tea-Districts but of less importance in Southern India.

It occurs throughout the tea-gardens in Assam. The collection of the bags is the simplest remedy, and this is best done after the usual pruning of the bushes. The pruning exposes them to view; there is a further advantage in collecting them at that time because the bags are full of eggs then. The pest is decreasing now, probably on account of the above measures having been adopted. **Mr. Andrews.**

Does it occur in any particular localities or generally all over the Districts? **Mr. Fletcher.**

The pest is always bad where the bushes are not thinned out at the pruning season. **Mr. Andrews.**

Do you know anything about the particular species of *Clania* which occur as pests? **Mr. Fletcher.**

Of the allied species, *Clania crameri* is the worst pest. **Mr. Andrews.**

We will go on to the various species of *Heterusia.* In Southern India we have *Heterusia virescens* as a pest of tea, and in North-East India there is *Heterusia magnifica* and a group of doubtfully distinct species regarding which Mr. Antram had a paper some years ago in the Bombay Natural History Society's Journal. I have not myself seen *Heterusia* on tea in India, but I have seen *Heterusia cingala* on tea in Ceylon. So far as I know the habits of all the species are very similar. One gets an enormous swarm of larvae in a very restricted area, often three or four acres in one corner of a field, where every bush is swarming with the larvæ which do great damage; but the outbreaks are sporadic and rarely recur for some time after each attack as the larvæ are very heavily parasitized by Tachinid flies. **Mr. Fletcher.**

In the Duars the caterpillars generally swarm out of the jungle and get into the Tea Plantations. At times the attack is very bad. Sometimes large swarms of moths are seen in certain localities, but the consequent damage from their caterpillars is not much. **Mr. Andrews**

Are there any particular conditions under which such outbreaks occur ?

There is no evidence as to what conditions are favourable to a sporadic attack of Red slug, but there seems to be a breeding ground somewhere in the Tondoo Forest in North Bengal ; gardens situated close to this forest are most subject to attack.

In Southern India, in the case of *Heterusia virescens*, the pest is cleared out by hand-picking.

Do you not find any difficulty in getting that done ? In the case of *Heterusia cingala*, my recollection is that in Ceylon there was some difficulty in collecting the larvæ by hand-picking on account of their stinging.

The caterpillars do sting but on the estate in question we had no complaints from the coolies.

The next insect is *Homona coffearia*, which is of course a very bad pest of tea in Ceylon. Whether it occurs on tea in Southern India appears to be rather doubtful ; I have not yet seen any specimens from tea and the only South Indian examples I have seen at all were a couple which I took at Pollibetta, in South Coorg, where there was no tea near. In North-East India Mr. Andrews has lately informed me that he has recently obtained it in small numbers, but, so far as we know at present, it does not appear to be a regular pest of tea in India. However, as it occurs in the Tea-Districts and is a potential pest of tea, we had better leave it on the Pest-List for the present.

In Southern India, however, we get another leaf-roller on tea. We have specimens reared from larvæ found twisting tea-leaves in the Nilgiris. But this species is *Laspeyresia leucostoma*. How far it is a regular pest I cannot say. If Mr. Anstead will try to procure us some specimens of these tea-rollers in Southern India, it will doubtless help out our present knowledge on this point.

I will try to get some specimens.

The next insect on the list is *Contheyla rotunda*, a small Limacodid moth, which was sent in to us recently by Mr. Anstead as damaging tea in the Wynaad. It is rather interesting, because this same species, which is apparently rather a rarity as a rule, suddenly appeared about a year ago as a pest of coconut in Malabar. Like a good many of these Limacodids, it probably feeds on various trees and plants and may occur on almost anything and, when it does occur, it appears in large numbers and does considerable damage for a generation or two, after which it disappears again. I do not think it is likely to occur regularly as a pest of tea.

It is said to be very bad in the Wynaad over small areas but I have not seen it myself. **Mr. Anstead.**

The next insect is *Dasychira (Olene) mendosa*. It is a polyphagous insect, occurring on tea occasionally as a minor pest, but does not appear to be of much importance. **Mr. Fletcher.**

The next tea-pest is *Andraca bipunctata*, which occurs in Assam, Cachar and Sylhet as a serious pest of tea. There are two broods, in January-February and in April-May. The whole of the leaves may be eaten off, leaving the tea-bushes stripped. The larvæ occur in conspicuous clusters and may be hand-picked.

Yes; they can be collected by hand easily and nothing else requires to be done. **Mr. Andrews.**

We now come to two weevils, both recently described by Dr. Marshall and stated to do damage to tea-bushes in Assam. They are, (1) *Phytoscaphus dissimilis*, recorded on young tea-shoots in Assam and (2) *Corigetus bidentulus*, recorded as a serious pest of tea in Assam and also occurring in Upper Burma. Perhaps Mr. Andrews can tell us something about them. **Mr. Fletcher.**

In Assam *Corigetus* is found on leaves but no control measures are practised because no satisfactory measure has been devised so far. In the case of old trees the damage done is negligible, because the tender leaves alone are eaten. **Mr. Andrews.**

That brings us to the end of the leaf-eating pests of tea. Has any one any other leaf-eating tea pests for discussion? [*To this question there was no reply.*] Then we will proceed with the boring insects which attack tea and with the borers we will include the bark-eaters also. I have the following species on my List, *viz.* :— **Mr. Fletcher.**

Xyleborus fornicatus.
Zeuzera coffeæ.
Phassus malabaricus.
Coelosterna scabrator.
Arbela dea.
Arbela quadrinotata.

Of these we have lately had some inquiries from Ceylon regarding the occurrence in India of *Xyleborus fornicatus*, the well-known "Shot-hole borer" of Ceylon, and we can only say that at present it seems rather doubtful whether this insect occurs in India at all.

Zeuzera coffeæ, the "Red Borer" of the Coffee Districts, occurs in tea as well as in various other plants. We have, for example, a record of its occurrence in cotton in Burma. I have seen it in tea in Ceylon and it occurs, boring in tea, throughout North-East India but is scarcely a serious pest.

Phassus malabaricus was reared from a larva found eating the roots of a tea-bush in Southern India, but is not a specific pest of tea, so far as I know.

Coelosterna scabrator is recorded by Watt and Mann as found on tea in Assam but is not a pest, I think.

We come now to the species of *Arbela*, known as Bark-eating Borers of tea in Assam. Mr. Antram wrote a bulletin on these insects and perhaps Mr. Andrews will tell us some more about them.

Both *Arbela dea* and *A. quadrinotata* occur in tea-gardens in North-East India. It has been found that the application of Soda washes is very effective in controlling them. After such treatment the caterpillars do not eat the bark.

Can you tell us something more about these washes, and how they are applied ?

Any of the following three solutions may be used :—

(1) Caustic Soda (98 per cent.)	2 lb.
Water	10 gallons.
(2) Washing Soda	7 lb.
Quicklime	2 lb.
Water	10 gallons.
(3) Soda Ash	2½ lb.
Quicklime	2 lb.
Water	10 gallons.

The soda wash may be applied by means of a brass spraying machine or, better, by means of a swab of cloth at the end of a short bamboo stick.

We now come to the various sucking insects, bugs, and scales, which attack tea, and with these we may consider a few miscellaneous pests such as mites and eelworms. On my list I have :—

Pœcilocoris latus.
Helopeltis theivora.
Helopeltis antonii.
Disphinctus humeralis.
Empoasca flavescens.
Lecanium hemisphaericum.
Lecanium nigrum.
Aspidiotus camelliæ.
Chionaspis manni.
Hemichionaspis theæ.
Aphids.
Thrips.
Tetranychus bioculatus.
Phytoptus carinatus.
Eelworms.

Pœcilocoris latus is a large Pentatomid bug which is apparently confined to North-East India.

Mr. Andrews. The damage it does in North-East India seems to be problematical.

Mr. Fletcher. Is it not an agent for damage to tea-seeds by a fungus ?

Mr. Andrews. Yes ; there is a fungus which gets into the tea-seeds through the punctures made by the bugs, but this fungus is also found in seeds which have not been punctured.

Mr. Fletcher. And as regards control ?

Mr. Andrews. Control is simple and consists only in hand-collection of the bugs and killing them.

Mr. Fletcher. We will go on to *Helopeltis* and *Disphinctus*. There has been considerable confusion with regard to the various species of *Helopeltis* found on tea, and their distinctions were dealt with by Dr. Mann in Vol. I of our Entomological Memoirs. Roughly speaking I believe that in North-East India the common " mosquito-blight " of tea is *Helopeltis theivora*, whereas in South India we get *Helopeltis antonii* and doubtless *Disphinctus humeralis* is often mixed up with this. It is possible that *Helopeltis cinchonæ* also occurs in Southern India, but we shall have to study a good deal of material in good condition before we can say much about its identity. I have not myself seen *Helopeltis* on tea in India, so I will ask Mr. Anstead and Mr. Andrews to tell us their experiences.

Mr. Anstead. In Southern India *Helopeltis* is worst in the monsoon. Spraying is out of the question then, but hand-catching is of some use. It also flourishes on a kind of wild palm, and removal of these trees is useful. It also feeds on *Cinchona*. In the Wynaad one finds a bush infested here and there, but it never does any appreciable damage.

Mr. Andrews. Spraying on a large scale is impossible in North-East India. When *Helopeltis* occurs in isolated patches, spraying with lime and sulphur combined with plucking of bushes outside and inside does some good. Many spray materials have been tried against *Helopeltis*, but none can be used successfully on a large scale, owing to the labour conditions, shortage of water, the fact that *Helopeltis* is at its worst during the rainy season, when spray materials are rapidly washed off, etc. Also, none of the spray materials tried have been found to be really efficacious even under favourable conditions. The fact that the bushes are grown for the young leaves, which are the most tender parts of the plant, is a difficulty ; how much so might be gathered from the fact that the first stage larva can resist a formalin solution of twice the strength which would burn the young shoots badly. However, spraying with lime-sulphur solution has been found beneficial in some estates where only small patches of tea were affected, but a second spraying is invariably necessary eight days later to deal with individuals which were in the egg stage at the

time of the first application, and the spraying, wherever possible, is usually supplemented by plucking off all young shoots, care being taken to pluck those in the heart of the bush as well as on the plucking surface. Hand-catching by small boys is almost universal.

A study of the distribution of this pest brings out several curious facts. It occurs, at its worst, in the Terai and Duars, and in those parts of Cachar, Sylhet and Assam which approximate to the hills, and where there is a liability to dull, rainy weather, with absence of sunshine and heavy rain for long intervals. This sort of weather is exceptionally favourable for the development of *Helopeltis*, and it has been found possible, by plotting curves based on the number of rainy days, and the amount of fall per day, to correlate conditions and intensity of attack. In the Duars there are two distinct types of soil. One is a grey loamy soil, the other a stiff red clay. It was noticed that most of the badly affected gardens were on the grey loam, gardens on the red clay being much less liable to attack in most cases. Examination of the analyses of typical samples of these soil types showed that the ratio of available potash to available phosphoric acid was high in the red clay soils and low in the grey loams. Samples from red clay soils which were becoming liable to attack were found to occupy an intermediate position. In Cachar *Helopeltis* attack is worst on the *bheels*, least on the red *teelas* and here, again, the same differences in the ratio were found to obtain. Experiments were therefore carried out, to ascertain whether, by increasing this ratio, the bushes in a soil could be rendered less liable to attack. The first experiment, carried out in a garden in Cachar, consisted in the application of sulphate of potash, and this gave excellent results, even though the potash was applied towards the end of the season. During the next season an extended series of experiments was drawn up, to be carried out on estates in the Duars and Cachar. Owing to the outbreak of War, the series could not be carried out *in toto*, but beneficial results were obtained, on both the red clay soils and on the grey loams, in certain cases Last season further experiments were carried out, and it is significant that, on estates where results had been obtained before, similar results were again obtained. Thus evidence has been obtained to show that an addition of potash, in a readily soluble form, to a soil, will, under certain conditions, produce a decrease in the liability of the bushes growing in the soil to *Helopeltis* attack. One of the conditions necessary for this treatment to be effective appears to be a shortage of *total* potash in the soil. In the case of the grey loam of the Duars, however, we find that while the total amount of potash in the soil tends to be slightly on the high side, and the total amount of phosphoric acid tends to be on the low side, the "available" quantity

of potash is low, in some soils of this type being merely a trace while the "available" quantity of phosphoric acid is exceedingly high, more so than in any other soil in tea. Addition of potash to such a soil is not of great value, and it would seem that it is fixed, and rendered non-available almost as soon as it is added. The problem before us, therefore, is to discover the factor or factors which bring about the fixation and liberation of potash and phosphoric acid in the soil, and future work is to be directed to this end.

The soil, of course, does not act directly on *Helopeltis*, but must act indirectly through the bush. An inquiry was therefore instituted to ascertain whether any relation could be traced between the attack of the pest and the composition of the leaf on the bush, which could be correlated with differences in the soil. Samples of leaf were taken from three estates at intervals of a fortnight throughout the same season and analysed. On one estate, *Helopeltis*, though serious in some years, did not appear that season. On the second estate the pest was serious, and became more so as the season progressed, but the area never reached a stage at which it failed to give leaf. On the third estate the bushes shut up entirely at the end of August. The results were exceedingly interesting. On the first estate the ratio of potash to phosphoric acid remained fairly constant throughout the season. On the second estate this ratio gradually increased, the rate of increase becoming greater as end of the season was approached. On the third estate the ratio increased still more rapidly, and in August this increase was so rapid that the curve became almost vertical. This experiment needs to be repeated, and the differences observed are rather the result of attack than the cause of it, but here again the ratio of potash to phosphoric acid is seen to have a bearing on the question.

Experiments have also been tried, by injection of bushes with soluble mineral salts, and by keeping plucked shoots with the cut end of the stalk immersed in different solution, to see whether differences in liability to attack could be brought about. Differences have been observed, but the experiments have not yet been carried far enough for any definite statement to be made.

Mr. Anstead. In Southern India the case is entirely opposite. The larger quantity of soluble phosphate gives the best results.

Mr. Andrews. The ratio is the chief point.

Mr. Anstead. I mean "ratio" by the "soluble phosphate". The composition of the soil varies considerably in the Planting Districts in Southern India. Consequently soil surveys are the first necessity. For want of exact information on this point, several manurial experiments are vitiated.

At Coimbatore *Helopeltis antonii* breeds on Nim shoots, as described in my note in the *Agricultural Journal.*

At Tezpur *Helopeltis* (*theivora*) has also been found breeding on mango.

We will go on to *Empoasca flavescens*, which is said to occur abundantly on tea in Assam and the Duars. Doubtless Mr. Andrews can tell us about that.

It is found all over the Hills in North-East India. The leaves of the attacked bushes get a peculiar flavour which improves the quality of the tea made from them. In the Plains this insect does not give such a marked flavour and may do harm. In one instance, three years ago, *Empoasca* suddenly appeared in the middle of a 5,000 acre block of tea in Assam in June, and completely checked the growth on one section. It had not been known there before for at least twenty years back ; it never spread to any other section ; it lifted in July, and has not reappeared since. Why it apeared, where it came from, and why it has never reappeared, I can not say.

We will go on to Scale Insects, on which there is a paper by Green and Mann in Vol. I of our Entomological Memoirs.

In Southern India the worst scale is *Aspidiotus camelliae*, which is very troublesome on young plants. Spraying is the best remedy and this is easy on young plants.

Chionaspis manni is another bad pest of tea-bushes. It interferes with the ordinary processes of digestion of the plant ; as a result of the attack the shoots get starved below the point of attack. It is serious in the Darjiling District only. The application of Soda Wash in the Cold Weather is the best remedy.

In South India, Pink and Purple Mites do more harm to the tea than any other mites. Spraying is very difficult as a control-measure.

Red Spider is bad in North-East India. Lime-Sulphur has been found to be the best treatment and, if well prepared and well applied, is successful cent. per cent. Soap solution is also useful and soaps containing a higher percentage of Sodium Silicate give better results than purer soaps.

Can you tell us something about the Lime-sulphur treatment ; how the spray is prepared and applied ?

A stock solution is made of 20 lb. Quicklime, 22½lb. Sulphur, and 50 gallons of water. This is diluted to one in ten with water and applied by means of a Sprayer. The best machine for the purpose is the Holder Knapsack Sprayer, made of "Virex" brass alloy. Copper vessels should not be used.

The difficulty with all these spraying materials is to secure a standard uniform quality. Samples submitted for trial may be good, but subsequent supplies do not always reach the same standard. **Mr. Anstead.**

That is our experience also. **Mr. Fletcher.**

[*Various delegates gave examples, and the general opinion of the Meeting was to the effect that a proper standardization of all proprietary insecticides in India is of great importance.*]

Aphids are very bad in nurseries in Southern India. **Mr. Anstead.**

And in North-East India. **Mr. Andrews.**

Tobacco and Soap sprays seem to be indicated. **Mr. Fletcher.**

Thrips is bad in Darjiling and the Plains. There are two varieties; one the Black Thrips and the other the Common Thrips. The lifehistory of the Common Thrips is as follows:—the egg is laid inside the young leaf; it is very minute, and invisible to the naked eye; the larval stage appears to go on for three weeks or more; the pupa is found in the soil; the adults appear in May and it appears that there are not more than two broods in the year. Several spray mixtures have been tried:— **Mr. Andrews.**

(1) Cook's (?) Nicotine.
(2) Lime Sulphur.
(3) X E X.
(4) Katakilla.
(5) Crude Oil Emulsion.

Of these, X E X was found to be the best. The composition of this substance is not definitely known, but the active ingredient was found to be acid, and of a fatty nature. In trials, the incidence of the pest was reduced to 5 per cent. in treated plots as compared with 50 per cent. in untreated controls.

Lime Sulphur was found to be the next best, and Nicotine Solution came next. Katakilla and Crude Oil Emulsion were not found to give good results.

As the larvæ enter the soil to pupate and apparently remain there for some time, could not cultural methods be employed successfully in the spring months? **Mr. Fletcher.**

This will be useful but only if done before May when the adults emerge, and if the cultivation is deep enough to reach the firm soil in which the larvæ pupate. **Mr. Andrews.**

Regarding the Black Thrips, the egg has not been found so far, but the larva is known; the pupa is found in the lichen on the bushes, and there are probably two broods in the year. **Mr. Andrews.**

Soda Wash is the best method because it removes all the lichen which gives shelter to the pupa.

Any more pests of tea? **Mr. Fletcher.**

Another mite, as yet unidentified, which is usually a minor pest, did great damage last year in the Terai. The damage caused is much like the effects of Canker.

That brings us to the end of Tea-pests. Of course, I know that most of you are not directly concerned with pests of tea as such, but many of these insects are not confined to tea and this discussion has brought out many points of general interest, such as the connection between soil-contents and the incidence of *Helopeltis* and the value of spraying and other insecticidal methods. I am sure that we are all indebted to Mr. Andrews for the information he has given us. We will now consider the pests of Coffee.

COFFEE (*Coffea arabica.*)

We will take first the leaf-eating species :—

Estigmene lactinea.
Creatonotus gangis.
Olene mendosa.
Parasa lepida.
Belippa ferruginea.
Homona coffearia.
Aularches miliaris.
Leaf-miner.
Sympiezomias frater.
Sympiezomias cretaceus.
Serica pruinosa.

None of these are of any great importance as pests of coffee in India.

Estigmene lactinea, *Creatonotus gangis*, *Olene mendosa* and *Parasa lepida* are all examples of polyphagous species which may occur sporadically on coffee.

Belippa ferruginea (*laleana*) is the curious, squat, rounded, pale green, gelatinous, slug-like larva which is found commonly on coffee-leaves. It occurs in some numbers in Coorg, but cannot be said to do damage, so far as I know.

Homona coffearia probably breeds on coffee in Coorg because, as I told you when discussing this species in connection with tea, I took examples at Pollibetta, where they must have bred on coffee. However, we know nothing of its occurrence as a pest of coffee in India.

Aularches miliaris is sometimes found in large numbers on Coffee Estates, usually on paths or in open spaces. They apparently congregate for pairing and are sluggish and fairly easily killed by beating with sticks or any similar simple means. The immature hoppers are found

on the coffee-bushes and may do a little damage at times, but *Aularches* can hardly be classed as a bad pest of coffee.

Then there is a Leaf-miner which is quite common in the Coffee Districts in Southern India. It is probably a fly but I have never been able to rear anything out, although I have collected scores if not hundreds of mined leaves. It is more of a curiosity than a pest, but I mention it in case any of you may be able to rear it out successfully.

Then there are the two weevils, *Sympiezomias frater* and *S. cretaceus*, which occur on coffee-bushes in Southern India and nibble the leaves; but they are scarcely pests.

Serica pruinosa has also been reported (I.M.N. III. 117) as defoliating coffee-bushes at Devikulam in the Madura District in June 1892 and also in Travancore (I.M.N. III. No. 6 p. 3).

Then we come to pests of Coffee-seedlings, and here we meet with two serious pests :—

Euxoa segetis
Pseudococcus (*Dactylopius*) *citri*.

Euxoa segetis is a common cut-worm in the Hills of Southern India and has been recorded as doing serious damage to Coffee-seedlings in Mysore.

Apterite has been tried and found useful in such cases. **Mr. Anstead.**

Usually in the case of these cut-worms, mechanical measures, such as grubbing up the soil with a stick and collecting the larvæ, give the best results. **Mr. Fletcher.**

Pseudococcus citri is sometimes a bad pest of young coffee-plants especially after they have been planted out. When in South Coorg I saw a good many cases of this, and in some cases at all events Apterite had been used quite successfully. **Mr. Fletcher.**

Dactylopius is particularly bad in South Coorg, and Apterite has been tried there with great success. It is applied, generally before the monsoon, in rings about an inch deep around the seedlings. **Mr. Anstead.**

Has anyone else tried Apterite? **Mr. Fletcher.**

I have tried it against Ground-beetles but did not find it of much use. **Mr. Ghosh.**

Besides *Pseudococcus*, we have several insects which attack the roots of coffee-bushes although we know very little about them. There are several Melolonthid grubs, one of which is probably *Holotrichia conferta*, which Mr. Anstead has sent us from Santikoppa, in North Coorg. Cicadas, again, emerge in some districts in enormous numbers from the ground in certain years, and, although we really know nothing of their lifehistories in India, we may presume judging from the records of lifehistories in other parts of the World, that they spend their early stages as root-feeders and therefore may do damage to coffee. It seems very probable **Mr. Fletcher.**

that we may have in Southern India some long-lived species comparable to the well known "17-year Cicada" of North America, but exact records of the emergence of large swarms are required.

We will go on to the Boring Pests of Coffee. These include

Xylotrechus quadripes
Zeuzera coffeæ
Collyrine beetles.

Of these *Xylotrechus quadripes*, the "White Borer" of the Coffee Planters, is by far the worst pest and did a tremendous amount of damage two years ago in South Coorg. On one group of estates, of about 500 acres, approximately 100,000 coffee-bushes had to be taken out and destroyed, and of course replaced by young plants, and all this destruction occurred in one season. That will give you some idea of the damage done. I visited Coorg in connection with this at the end of 1915 and did some work on the lifehistory of the beetle and control-measures but, before discussing these, I will ask the Mysore delegate to give us their experiences.

I will ask Mr. Kunhi Kannan to give an account.

Xylotrechus quadripes is a very bad pest of coffee in all areas in Mysore where coffee is grown. An alternative food-plant has been found by Dr. Coleman, but I forget its name. [Name has since been given as *Olea dioica* Roxb.]

Was it *Wendlandia*? There is a *Wendlandia* (*notoniana*) common around Mercara which I thought, when I was there, was a probable food-plant of *Xylotrechus*, although I did not actually find any larvæ in it.

I cannot remember the name.

The eggs are laid in the bark in cracks and crevices.

Here is an unpublished coloured plate, which was done here from my material brought back from Coorg. It shows the egg and all stages and method of attack, and may help to illustrate your account.

The egg takes six to nine days to hatch in Mysore. The grub bores into the tree and penetration takes a circuitous route to reach the wood. The larva lives for nearly a year. Young trees, of four to five or six years, are damaged most and these trees cannot survive the attack.

As regards remedial measures, scrubbing the bushes is the only satisfactory thing to do, and this should be done once in the middle of November and again at the end of the month. Coconut brushes have been found to be the best to use for scrubbing. These brushes are made from husks of coconuts cut in two transversely; the cut ends are then beaten out and made into a sort of brush. The idea in scrubbing is to kill all the

eggs and the young larvæ that have not yet penetrated into the trees. Experiments to test the relative efficacy of (1) Scrubbing and (2) Scrubbing and whitewashing have been conducted over nearly 4,000 plants. The results will be available next cold weather.

Mr. Anstead. The beetles are found in the spring also. Is there a second brood?

Mr. Kunhi Kannan. That is only a case of deferred emergence.

Mr. Fletcher. Have you found any natural enemies of *Xylotrechus*?

Mr. Kunhi Kannan. Two Hymenopterous parasites have been noticed. Their eggs are apparently laid on the grub when it is just below the bark. Amongst birds also, the Blue Barbet extracts the larvæ by peeling off the bark. Nearly ten per cent. of trees pulled out by planters for borer have been found to have had the larvæ extracted in this way.

Mr. Fletcher. I have seen a blue Ichneumonid hunting over the bushes as if in search of *Xylotrechus* grubs; unfortunately I was not able to obtain specimens, but it was probably *Xylonomus cærulescens*.

Regarding birds, one often sees bushes ripped open by birds, and the planters say that they extract the grubs of *Xylotrechus*. I cannot say what the birds are, but I imagine that they are woodpeckers of sorts. But the point that strikes one in the Coffee Districts, in Coorg at least, is the great scarcity of birds. This is undoubtedly due largely to the fact that the Arms Act does not apply to Coorgs and that the jungle tribes employed on estates carry bows and shoot and eat every bird they can knock down. It is quite common, in walking along a path through the coffee, to come across a few stones put together, with the remains of a fire and a few feathers scattered on the ground, to show where some small bird has been knocked down and cooked and eaten on the spot. So I do not think that birds are a very important factor in checking *Xylotrechus*, and as regards parasites these do not seem to be at all common.

Mr. Kunhi Kannan. If we have heavy showers at the time eggs are being laid, the damage caused by these beetles in the following season will be much less.

Mr. Ghosh. Are the eggs so loosely laid on the bark that they are washed away by rain?

Mr. Kunhi Kannan. I cannot explain this, but that is the general experience. I believe that the result is due to the constant dripping of water along the trunks during the heavy rains.

Mr. Fletcher. Would not the effect of rainy weather tend to reduce oviposition, as the female beetles only fly freely on warm, sunny days? I should think that is a more likely explanation.

As regards the eggs, they are thrust right into the bark, usually under the loose scales that one finds on older coffee-bushes and would not be likely to be affected very directly by rain.

Have you tried the effect of any deterrents to prevent egg-laying?

Several deterrents have been tried, but not a single one has been found successful.

That was my experience in Coorg also. On one estate where Jeye's Fluid was used, I examined some bushes about a week after it had been applied and had little difficulty in finding healthy eggs under the bark. All these deterrent washes only seem effective so long as they retain a strong smell over the stems and branches.

Can you tell us how many eggs are laid by each female beetle?

I cannot give any exact figures for oviposition, but by dissection I have found more than one hundred eggs in one beetle.

Probably about one hundred is the normal number. In one female which I dissected I found 108 eggs, mostly large and well-formed but about twenty-five per cent. were still small and undeveloped; this female, however, was caught as an adult and may already have laid some of its eggs.

Regarding the eggs, these are of indeterminate shape, long, rounded at the ends, white, and soft, and look rather like minute rice-grains. They are thrust singly, or in little groups of six or eight, inside cracks and under the bark; they are rarely visible without removing the scales of bark and are very rarely laid externally. Eggs laid on 1st November 1915 hatched out on 12th November, thus taking eleven days; but these eggs were kept all the time in the shade, so took perhaps a little longer than usual. The young larva bores into the stem either under or alongside the place where the egg was laid, or not far off (perhaps a quarter-of-an-inch). It bores in rapidly and soon only the tip of its tail is visible. It first of all bores a gallery around the stem just under the bark and produces a ridge over its gallery which looks just as if a wire had been thrust under the bark; later on the bark usually cracks across the top of this ridge and makes it more conspicuous. You will see what I mean in the coloured plate. Then the larva bores into the solid wood and seems to burrow about more or less indiscriminately. Mr. Kunhi Kannan has just told us that the life-cycle lasts for a whole year, but as regards that I can only say that, so far as my experience goes, one seems to get two emergences of beetles, one in April-May and the other in November, the latter being far more numerous. Whether some descendants of the normal November brood emerge six months late, in April-May, after having taken 18 months to complete their lifehistory, or whether there is a definite emergence in April-May descended from parents which emerged the previous year in April-May or even whether there are two broods in the year, seems to me at present.

rather doubtful. I started some experiments at Pollibetta in November 1915 with female beetles caged over young coffee-bushes, which were presumably unaffected, to see when the next brood of beetles emerged, whether in May or November of last year; but unfortunately the experiments were upset by the departure of the planter in whose charge they had been placed. It is certainly the case in many of these wood-boring longicorns that the length of lifehistory is very variable and it may be so with this species. The question of the length of the lifehistory is an important one, as we certainly require to know this exactly before being in a position to recommend remedial measures.

Regarding these, so far as we know at present, the most promising scheme seems to be to prevent oviposition as much as possible and to kill the eggs and young larvæ off, if eggs have been laid, before the young larvæ have bored into the bushes. This can be done by scrubbing the bushes, as described by Mr. Kunhi Kannan, or by scraping off the loose scales of bark and so on with flat pieces of wood. It may be possible to find some satisfactory deterrent but, so far, nothing seems absolutely effective. I am rather inclined to think, from what I have seen, that lime-wash is of some use; if applied at the same time as the bushes are scraped, it has the further advantage of marking clearly those bushes which have been treated, as they stand out quite clearly and the work is easily checked over. For this reason I should be inclined to recommend the addition of lime-wash to any deterrent that may be applied. Some Coffee-planters have told me that lime-wash binds the tree, preventing the formation of new wood; but other Planters, of equal or greater experience, have told me that no such effect is produced.

One other control-measure, which I personally am rather in favour of, is the catching of the adult beetles. As we said just now, each female beetle (or, at any rate, each large female; for they vary enormously in size) may lay one hundred eggs and, even allowing for the fact that a proportion of captures will be males and of the females caught many will have laid a proportion of their eggs and that many eggs may be laid on one bush, we may safely say that every beetle caught and killed means a coffee-bush saved. There are, I know, objections to this by the Planters, who say that it is not practicable, but it certainly seems to me that this should be done.

Mr. Kunhi Kannan. The collection of beetles, on a basis of rewards paid for catches, has not been found successful on two estates where it was tried in 1915. The difficulty was to find the beetles.

Mr. Anstead. Instead of getting these beetles, the boys frequently bring in all sorts of other insects. There is also the objection that they will naturally collect the beetles where these are most plentiful, so that a Planter may

be asked to pay rewards for beetles caught beyond the limits of his own Estate.

I have heard both these objections advanced by Coffee-planters. As regards the recognition of the Coffee-borer beetles, there is a difficulty, and I have even come across Planters in two Coffee-Districts, who knew the Borer grub well but had not the least idea what the beetle looked like. I have even had *Aularches* sent in to me by a Coffee-planter with a request for information as to whether it was the Borer. But with a little trouble there should be no difficulty in recognizing *Xylotrechus*. As a matter of fact, when I was in Coorg in November 1915, we showed some beetles to a gang of small boys and sent them out with bottles to hunt for these beetles, and they brought in a very large number, practically all *Xylotrechus quadripes*. As regards the collecting of the beetles outside Estate limits to earn rewards, I think this should easily be arranged with a little supervision.

Another species which one finds in Mysore is *Xylotrechus subscutellatus*. This looks very like *X. quadripes* but does not lay eggs in the coffee-bushes.

Xylotrechus subscutellatus occurs in Coorg also, and I had a few brought in mixed up with *quadripes*. There is also a Mordellid beetle which is a most exact mimic of *X. quadripes*. Such species certainly could not be distinguished except by an entomologist, but the small proportion of such species brought in would not, in my opinion, invalidate the desirability of collection of Borer beetles.

We will go on to *Zeuzera coffeæ*, the "Red Borer" of the Coffee-planters. It occurs in all the Coffee-Districts, but does not seem to be very common as a rule.

It is not a very important pest of the coffee-bushes nor is it difficult to tackle. The branches that contain the borer die back and so may easily be located and lopped off.

Then there are the Collyrine Tiger-beetles whose larvæ are sometimes found boring in coffee twigs. But they are not pests as far as we know.

We will go to the Sucking Insects found on coffee. On my list I have :—

Antestia cruciata	*Lecanium hemisphæricum*
Coccus viridis	,, *nigrum*
Pseudococcus citri	,, *oleæ.*
Pulvinaria psidii	*Chionaspis biclavis.*

Of these, *Coccus viridis* or *Lecanium viride*, the "Green scale", is by far the most important, and as some work has been done on this in

Mysore lately I will ask Mr. Kunhi Kannan to give us some information about it.

Mr. Kunhi Kannan. This insect passes through three moults before attaining the adult stage. A peculiar habit in moulting has been observed in the case of this insect, that it casts off only the ventral skin and not the dorsal. The individual lifehistory takes about four months, about one-and-a-half months of this time being required to reach the adult stage.

Mr. Fletcher. What is the length of period during which young individuals can live before reaching a suitable food-plant?

Mr. Kunhi Kannan. They live for three or four days.

Mr. Fletcher. When I was in Coorg in May 1914 I collected some coffee-leaves infested with this Scale and young ones emerged in the boxes in which the leaves were. These boxes were carried by me when I left Coorg, and young ones were still alive and active ten or eleven days afterwards, although I was then at Poona where the weather was extremely hot and dry and the conditions apparently very unfavourable.

Mr. Kunhi Kannan. The adults may live for more than twenty days without food.

Mr. Fletcher. The adults in my boxes were apparently dead. Anyway, these figures show how this Scale may be carried for long distances even on dried leaves affected by it.

Mr. Kunhi Kannan. Another peculiarity noted in this Scale-insect is in regard to the number of antennal joints. Mr. Green, when describing this species, mentioned seven segments of the antenna, but I have found in the case of bred specimens that this number may be reduced to three. Further observations have shown that there is great variation in this species. No less than five different forms have been obtained from different parts of the World. The number three in the antennal joints of most of the South Indian forms is constant. It has therefore been described as a new species in a paper read by me last month before the Science Congress. The abundant rainfall in Mysore helps to check this pest, because during the monsoon months a white fungus, which is very destructive to this Scale insect, propagates very easily. A dark fungus, which appears to resist dry weather better, is also effective.

Dr. Coleman. A paper, recently published in Java, gives interesting results of experiments conducted to show the relation between Ants and this Scale. Coffee-plants were grown in pots and fifty bugs were put on each plant and ants introduced into some pots whilst others were kept free of ants; in the ant-infected pots the number of Scales doubled, whilst in the pots without ants their number was reduced. These ants keep parasites also from the Scales.

Another worker in Java, however, claims to have obtained results quite discordant with those I have just described.

The persistent destruction of ants-nests in the Coffee-Districts certainly seems to have had a marked effect on the spread of this Scale.

The fact that the ants take very great care of the Coccids they attend on has been observed many a time by me. In Pusa the workers of *Œcophylla smaragdina* have been noticed on several occasions removing the young *Lecanium hesperidum*, holding them very gently between their mandibles, from such leaves as get withered on account of the sap having been drained off, on to fresh and healthy leaves.

We must get on to the next insect. *Antestia cruciata* sometimes occurs in very large numbers on coffee in Southern India and is said to do considerable damage by sucking the berries.

It is very common in the Coffee-Districts but does not do much damage as a rule.

The other sucking insects do not call for much comment. We have already considered *Pseudococcus citri* on the roots of coffee; it is often found on the young shoots but not in large numbers as a rule. The other Scales I have already mentioned hardly seem to be serious pests.

RUBBER (*Hevea brasiliensis*).

We now come to pests of Rubber. So far we seem to be fairly fortunate in India in having practically no pests of this tree. In other rubber-growing countries things are not so satisfactory. In the Malay States, for example, one hears of trouble with a *Coptotermes* and in Ceylon there is a Slug with a curiously perverted appetite for rubber latex. In Ceylon also the larva of *Batocera rubus* has been recorded as boring in the lower part of the stem and doing some damage.

We have had *Batocera rubus* sent in a rubber stump from the Western Ghats.

The only insect I have seen on rubber in India, as a pest of any kind, is *Saissetia nigra*. One sees a few examples of this Scale-insect on rubber-leaves in most districts, but it never seems to be really serious.

Practically speaking, we have no insect-pests on this tree.

CARDAMOM (*Elettaria cardamomum*).

Cardamom is grown to some extent in the Hill Districts of Southern India, generally at an elevation of about 4,000-5,000 feet. Amongst insect pests we know of the following :—

Attacking the stem and capsules :—

Dichocrocis punctiferalis.
Lampides elpis.

Cardamom Scolytid.

In the roots :—

Hilarographa caminodes.

Sucking :—

Stephanitis typicus.

Of these *Dichocrocis punctiferalis* and *Lampides elpis* are generally distributed minor pests. The Cardamom Scolytid occurred very abundantly in the capsules in Coorg four or five years ago and damaged about fifty per cent. of the crop in some localities but does not seem to have occurred again recently.

Hilarographa caminodes is known from Ceylon, but has not yet been definitely recorded from India ; however, it probably occurs, so we had better keep it on our Pest-list.

Stephanitis typicus is a very minor pest, so far as we know.

CINCHONA.

Cinchona is grown in a good many Hill localities in India, but we know of few pests except in South India. **Mr. Fletcher.**

On the leaves we get *Deilephila nerii* and *Sympiezomias decipiens.* *Deilephila nerii* is not common on Cinchona as a rule but sometimes occurs and, when it does occur, may do damage by stripping off all the leaves, especially of young trees, as I have myself seen in Ceylon. *Sympiezomias decipiens* is a small weevil which was reported about three years ago as doing considerable damage to Cinchona leaves in the Nilgiris ; it was then an undescribed species and we know little more about it now.

There are a few sucking insects. Those on my list are :—

Helopeltis antonii.

Coccus viridis.

Aspidiotus camelliae.

Chionaspis biclavis.

Of these *Helopeltis antonii* is usually common and often does some damage. The Scales are of minor importance.

In the Darjiling District we get *Helopeltis theivora* on Cinchona. **Mr. Andrews.**

Then at the roots we get Cockchafer grubs, belonging to various species of *Anomala* and *Holotrichia.* **Mr. Fletcher.**

These grubs occur in enormous numbers at roots of Cinchona in the Nilgiris. I have visited the Cinchona Plantations and collected large numbers, and these are at present under rearing in the Insectary at Coimbatore. **Mr. Ramakrishna Ayyar.**

And as regards control measures ? **Mr. Fletcher.**

Apterite has been tried against these grubs and found successful. **Mr. Anstead.**

Camphor.

Camphor seems to be rather free from insect pests, as we might indeed expect to be the case. The only insect-pest I know of is a small Gracilariad (*Acrocercops ordinatella*), which mines the leaves. This was sent in to us from Mysore by Mr. Anstead as doing some damage. I have not been able to obtain it again.

We will go on with the insects of a few plants which I have listed under the heading of :—

MISCELLANEOUS.

They are hardly crops but you may have to deal with insects found on them.

Mimusops Elengi (Bakul).

This is a small tree which is grown commonly for its ornamental appearance and for the flowers. The leaves are sometimes attacked and considerably damaged by larvæ of *Metanastria hyrtaca*.

A *Thrips* is very bad on this tree at Coimbatore.

Rain-tree (*Pithecolobium saman*).

The rain-tree is another miscellaneous tree, of no great value, but often grown as a roadside shade or ornamental tree, so that you may be called on to treat it for pests. It does not seem to have many serious pests but is sometimes bored by *Arbela* and must therefore be considered as an alternative food-plant where this insect does damage to crop-trees.

In the Duars the leaves are stripped by the beetles of *Astycus chrysochlorus*.

In Coimbatore on one occasion some kind of Lac was found in thick incrustations on the branches of this tree.

Lantana (*Lantana aculeata*).

We now come to *Lantana*, about which I said something yesterday. *Lantana* was originally a South American shrub which was introduced as an ornamental garden-plant. I believe that it was introduced into Ceylon about the year 1828 and it has presumably been in India for seventy or eighty years now. In some districts it has quite got out of hand and become a weed pest of the worst description, choking out all other vegetation, and this has become a serious matter already in many parts of Southern India and Ceylon and will, I think, in the near future prov

even worse in North-Eastern India and Burma by invasion of forest and grazing areas. It has become such a nuisance in Coorg that it has been found necessary to introduce special regulations for its control. I told you yesterday what is being done in India to try to find any insects which will keep it in check and Mr. Ramachandra Rao will give us a brief account of this work so far as he has gone. In the meanwhile I will read out the names of a few insects which are down on my list as attacking *Lantana*, but this list is of course very incomplete in this sense that you will find on *Lantana* a large number of insects which are only casual feeders on it.

The insects attacking the flowers and seeds are obviously of the greatest importance, since *Lantana* is spread, so far as we know, entirely by birds, chiefly mynahs, eating the ripe fruits and dispersing the undigested seeds. So that any insects, which will check the production of ripe seeds, will tend to keep in check the spread of *Lantana*.

Attacking the flowers we find :—

Platyptilia pusillidactyla.

A Eucosmid moth.

Of these *Platyptilia pusillidactyla*, which is one of the species introduced artificially from Mexico into Hawaii to check *Lantana* there, seems to occur already all over India, Burma and Ceylon wherever *Lantana* is found. The eggs are laid on the buds or flowers and the whitish, naked larva is found curled up inside the young flowers, whose interior is eaten out so that, instead of a large bunch of healthy berries being formed, one finds only three or four small, unhealthy-looking ones. This little moth is therefore of some use but, although (as I said) it occurs commonly wherever you find *Lantana*, it is not abundant enough to form an effective check on the formation of fruits.

The Eucosmid, which seems to be an undescribed species nearly allied to *Lobesia œolodes*, has been found by Mr. Ramachandra Rao around Coimbatore.

Then there are a few sucking insects which are not confined to *Lantana* but which seem to occur on it in some numbers and may perhaps affect its growth by impairing the vigour of the plant, but these sucking insects are not so useful as those which destroy the flowers. They are :—

Piezodorus rubrofasciatus.

Plautia viridicollis.

Plautia fimbriata.

and of these the species of *Plautia* seem especially attached to *Lantana* and may perhaps do a little good.

Mr. Ramachandra Rao. The work of investigation of *Lantana* insects has only been in progress for a very short time, about two months, and it is rather premature

to say much about it as yet. I have made a start at this work at Coimbatore and have examined *Lantana* and collected and reared out the insects found on it at and around Coimbatore. A very large number of insects are found on *Lantana*, and of these *Platyptilia pusillidactyla* and the *Eucosmid* seem at present the most promising.

[*A coloured plate showing the lifehistory of Platyptilia pusillidactyla was exhibited.*]

Will any of the indigenous insects be able to exercise any more influence, than they are at present, in checking *Lantana* ?

Probably in some unknown corner of the country are some insects which form an efficient check. The question certainly requires investigation and, if any such insects are found, we can introduce them to other localities.

That is of course the object of the present investigation.

At Bangalore in my compound I found an isolated plant of *Lantana* badly affected by a white Scale-insect. This Scale kills back the shoots on which it occurs.

I expect the Scale you refer to is *Orthezia insignis*. I have not seen this in India, but I have seen it in Ceylon and it certainly does kill back the *Lantana*. The affected shoots die back and become black, as if scorched, but the Scale seems to occur only in patches and can hardly be looked on as an effective check. Besides, it is not confined to *Lantana* but has a very wide range of food-plants, and is often a very bad pest of cultivated plants. I have here Essig's " Injurious and Beneficial Insects of California ", in which you will see figures of this Scale, and I will just read out what he says about its food-plants :—

> " Is especially destructive to *Coleus* spp. It also attacks *Amaranthus* sp., *Chrysanthemum*, *Lantana*, *Verbena*, *Ipomœa*, *Thunbergia*, *Strobilanthes* " [there are plenty of wild species of *Strobilanthes* in the Hills of South India], " *Achillea*, *Salvia*, *Cuphea*, *Capsicum*, *Ageratum* " [the common " White weed " of the Planting Districts], " *Vernonia*, *Gardenia*, *Lonicera*, *Citrus* sp., tea, strawberry and tomato ",

so I don't think that is an insect to be encouraged in any case.

In connection with Mr. Ramachandra Rao's work, I think it will help us considerably if all the Entomological Assistants in the Provinces will gather together any information they can about *Lantana* in their several Provinces—its present distribution, whether it is spreading or decreasing in any areas, and any facts about insects found on it. If you will make a start now and get this information together, it will be available when Mr. Ramachandra Rao comes around later on to make his investigations locally.

PRICKLY PEAR (*Opuntia* sp.).

Prickly Pear comes in much the same category as *Lantana* as it is **Mr. Fletcher.** liable to become a weed-pest when it gets out of hand. It is not looked on as a nuisance, however, in most parts of India, so that we are not concerned with it to any great extent, but, as you may remember, the Queensland Government sent out a special Commission about five years ago to investigate the possibility of introducing insects into Australia to keep it in check there. I tell you of this just to remind you that, if you should come across any insects killing back Prickly Pear, they are of some economic interest and we should like to know more about them. We do not seem to have any insects checking Prickly Pear to any great extent in India, and about the only ones I know of are Meloid beetles, which eat the flowers, and a Scale-insect, *Diaspis echinocacti*, which occurs in Bombay. There are also a few other Scales to be found but they seem to exercise no check on the plant.

We will now go on to the

LEGUMINOUS FIELD-CROPS,

under which we will discuss the various Pulses and Green-manure crops and also Indigo and a few other cultivated plants. It is, I think, most convenient to take these together, as their pests are very similar in many cases.

CAJANUS INDICUS (Tur, Arhar, Red Gram).

A very large number of insects are found on this plant and undoubtedly **Mr. Fletcher.** they do a great deal of damage in the aggregate although there are few which occur in destructive numbers as a rule. We will take the Leaf-eating insects first of all. Of these I have on my list :—

Eucosma critica.
Astycus lateralis.
Myllocerus 11-pustulatus (*maculosus*).
Gracillaria soyella.
Cyphosticha coerulea.
Monolepta signata.
Stauropus alternus.
Episomus lacerta.
Megachile anthracina.
Megachile disjuncta.
Solenopsis geminata.
Meranoplus bicolor.

We will take these one by one.

Eucosma critica, hitherto called *Eucelis critica* in Indian entomological literature, occurs fairly commonly in most parts of India, the larva bunching up the shoots and leaves.

It occurs all over Madras as a minor pest.

It occurs in Bombay as a minor pest.

It is a minor pest of *tur* in Bihar.

In the Central Provinces it is a minor pest.

In Bengal it is a minor pest.

In Assam it occurs as a minor pest.

It is not a pest in the United Provinces.

I have never noted it in the Punjab.

As a pest it is found on young plants only.

Then it occurs as a minor pest all over India south of the United Provinces. The obvious control measure is the picking off of the twisted tops in the case of young plants.

Astycus lateralis. We have this recorded from Nagpur, and it also occurs at Pusa, but is not very common and scarcely a pest.

Myllocerus 11-pustulatus (*maculosus*). This is the commonest of these leaf-eating weevils at Pusa but does relatively little damage and we can scarcely call it a pest.

It occurs in the United Provinces but not as a pest.

Gracillaria soyella and *Cyphosticha coerulea.* Both these little Leaf-miners occur commonly at Coimbatore and at Pusa and doubtless they are widely distributed throughout India. They are scarcely pests.

Monolepta signata occurs on *tur* as on many other crops, but is unimportant.

In Burma it occurs as a minor pest.

Stauropus alternus. The larvæ are found occasionally on *tur* but usually only in small numbers and may be looked on as curiosities rather than as pests. We must remember, however, the serious outbreak of this species on tea in Ceylon, so that it must be looked on as a potential pest of *tur* also.

It was once found at Dacca on *tur* leaves.

Episomus lacerta. We have a record of this on *Cajanus* at Samalkota.

Young plants were found damaged at Samalkota.

It is scarcely a pest as a rule.

Megachile anthracina and *M. disjuncta.* These two bees occur commonly at Pusa and cut away portions of the leaves for their nests. They are scarcely pests.

Solenopsis geminata. We have a record of this ant as biting holes in the leaves at Mandalay. These ants are fond of tender leaves of various plants and many sometimes do a little damage.

Meranoplus bicolor was found biting holes in the leaves at Padu, in Burma.

Mr. Shroff. At Mandalay we also get a Flea-beetle which bites holes in the leaves.

Mr. Ramakrishna Ayyar. *Aproaerema (Anacampsis) nerteria* also occurs at Coimbatore, mining and folding the leaves.

Mr. Fletcher. Next we have the insects which attack the flowers of *Cajanus indicus*. On my list are :—

Zonabris pustulata and other Meloid beetles.
Ceuthorrhynchus asperulus.
Thrips.

Zonabris pustulata is one of the common red-and-black Meloid beetles occurring in India, the adult beetles feeding on flowers. Sometimes one finds them in numbers on *tur* flowers and they are fairly easily collected in hand-nets. There are several closely-allied species but the habits of all are very similar.

Mr. Shroff. We get *Zonabris* on the flowers in Burma.

Mr. Fletcher. Thrips also occur in the flowers and probably do damage, but this is a group of which we really know nothing in India.

Mr. Shroff. We get *Thrips* on the flowers in Burma.,

Mr. M. M. Lal. And in the Punjab.

Mr. Fletcher. *Ceuthorrhynchus asperulus* is a minor pest in Madras and is probably widespread. There is an account of it in my book on "South Indian Insects" [pp. 328-329, fig. 185] and there is little to add to that. If there is a long-extended pupal period in the soil, however, cultural operations seem to be indicated for control.

Next we have the insects feeding in the pods and here again we have a long list :—

Heliothis (Chloridea) obsoleta.
Catochrysops cnejus.
Polyommatus boeticus.
Sphenarches caffer.
Exelastis atomosa.
Maruca testulalis.
Etiella zinckenella.
Agromyza sp.
Bruchus chinensis.
Bruchus theobromae.

Heliothis obsoleta attacks *tur* commonly in most parts of India but is not a very bad pest as a rule. Cultural methods after harvesting the crop, to kill any pupæ in the soil, seem indicated for control.

Catochrysops cnejus occurs commonly in India.

And in Burma.

Polyommatus boeticus is also common. Both these butterflies do some damage and control on any field-scale seems impossible.

Sphenarches caffer is common in India and occurs everywhere with a very wide range of foodplants. It is quite a minor pest of *tur*.

Exelastis atomosa is also common and does more damage to *tur* than *Sphenarches*. It is a minor pest in most districts.

It occurs in numbers in Bombay and does considerable damage.

In the Sholapur District control is practised by shaking the plants over baskets and a small proportion of larvæ and pupæ collected in this way.

By shaking the plants, a few caterpillars may be got, but certainly no shaking will dislodge the pupæ.

The fact remains that some pupæ are collected in that way, but doubtless they form only a small proportion of the whole lot present and only consist of those attached to dried-up flowers, and so on, which get shaken off into the baskets. The method certainly does not seem very practical, but I quoted it as an example of a local control-method.

Maruca testulalis occurs commonly in most parts of India, as a minor pest, the larva boring into the pods. I do not think there is much to add to the account given in "South Indian Insects" [p. 440, tab. 36].

It occurs in Burma.

In Bombay it does some damage and the picking of affected pods is practised.

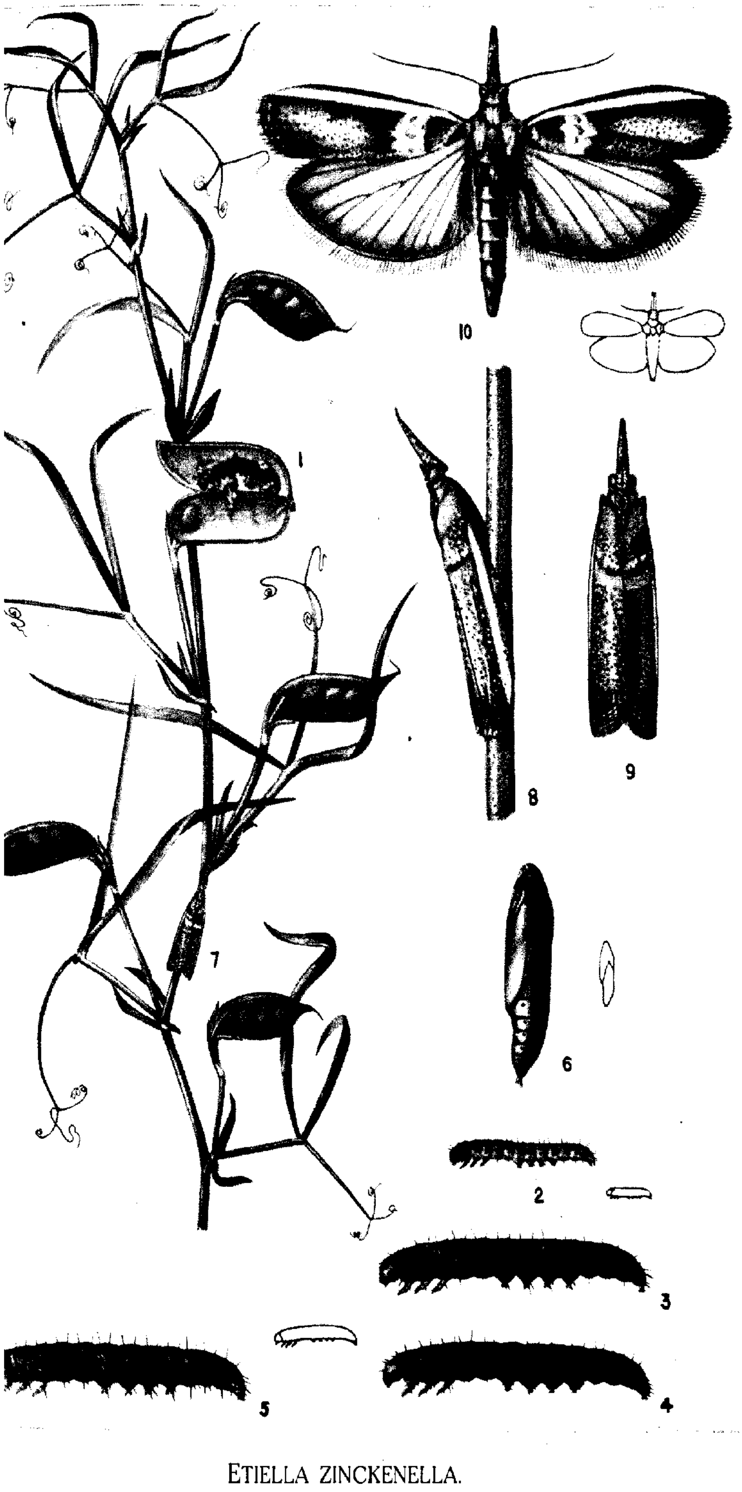
The picking of affected pods is not easy.

Etiella zinckenella. There is a short account in "South Indian Insects" [p. 429, fig. 305] and its lifehistory is shown in a new coloured plate, of which I have here an advance proof [*passed around for inspection*]. It occurs all over India and Burma as a pest of pulses and sann-hemp and sometimes does considerable damage. Control is difficult and we can do little at present. When the crop is harvested the caterpillars, which are then in the pods, leave them and may be collected in quantity and destroyed; this is, of course, rather late in the day, but it may help to reduce damage to subsequent crops, whether of *tur* or other similar leguminous plants.

Agromyza sp. This fly is still unidentified. It is figured and described in "South Indian Insects" [p. 357] and I have nothing more to add.

Etella zinckenella, Tr.

Fig. 1, ***Khesari*** pod opened to show the caterpillar inside.
Figs. 2 to 5, young and full-grown caterpillars showing different colour-forms.
Fig. 6, pupa.
Fig. 7, moth, natural size.
Figs. 8 and 9, moth in resting position (enlarged).
Fig. 10, moth, with wings spread.
Figs. 1 and 7 are almost life-size. The other figures are enlarged, the natural sizes being shown by the small outline sketches.



ETIELLA ZINCKENELLA.

Bruchus chinensis is also described and figured in "South Indian Insects" [pp. 306-307, fig. 155]. At Coimbatore it was found breeding on *tur* pods in the field. All these Bruchids, and their habits, badly want working out in India. Care should be taken to sow only uninfested seed and to avoid as far as possible having alternative food-plants growing near in space or time so as not to have any beetles emerging in the *tur* fields as far as possible; otherwise I do not see that much can be done on a field-scale, on the basis of our present knowledge.

Mr. Ramachandra Rao. *Bruchus theobromae* is also found in the fields at Coimbatore.

Mr. Ghosh. We have never found it at Pusa.

Mr. Shroff. In Burma, at Maymyo and Taungyi, there is an *Apion* whose grubs bore into the *tur* pods and feed on the seeds inside.

Mr. Fletcher. Any more insects eating the pods? Then we will go on to the sucking insects found on *tur*. On my list I have:—

Clavigralla gibbosa.
Clavigralla horrens.
Riptortus spp.
Cyclopelta siccifolia.
Anoplocnemis phasiana.
Graptostethus servus.
Coptosoma spp.
Aphis cardui.
Membracids.

Clavigralla gibbosa and *C. horrens*—the species are not easy to distinguish and have been considerably mixed up in economic records—are minor pests in most districts, especially bad around Poona. Shaking the plants over vessels of oil and water or over oily cloths seems the most practical remedy. Both species are described and figured in "South Indian Insects" [pp. 478-479, figs. 361-362].

Various species of *Riptortus* (*R. pedestris*, *R. linearis* and *R. fuscus*) occur on *tur*, as well as on various other grams, and suck the pods. *R. pedestris* is described and figured in "South Indian Insects" [pp. 480-481, fig. 364] and the others are all very similar. Collection by hand-nets seems the best control-measure. They often breed on wild plants, however, so that clean cultivation is also indicated.

Cyclopelta siccifolia is not very common on *tur* as a rule but sometimes occurs in numbers, when it may be collected by hand. It is described and figured in "South Indian Insects" (p. 476, f. 357).

Anoplocnemis phasiana occurs in small numbers as a rule and is scarcely a pest. It is described and figured in "South Indian Insects"

(p. 478, fig. 360). We shall have more to say about this insect when we come to deal with pests of *Erythrina*.

Graptostethus servus, also figured and described in "South Indian Insects" (p. 482, fig. 366), also occurs as a rule in small numbers and is scarcely a pest. Control as in *Clavigralla*.

Coptosoma of various species [see "South Indian Insects," pp. 469-470, fig. 345] sometimes occur, but less on *tur* than on *Sesbania* and other Leguminosæ. The bugs are active and are best caught in hand-nets.

Aphis cardui is common on the shoots but control measures do not seem to have been practised.

Membracid bugs of various kinds also occur, on the shoots principally, but are usually of quite minor importance as pests.

Membracids are found on the flowers, pods and shoots at Raipur.

We come now to the insects damaging *Cajanus indicus* by boring in the stem. In this class there are :—

Alcides collaris.
Sphenoptera arachidis.

Alcides collaris [described and figured in "South Indian Insects," p. 337, fig. 195] was recorded as doing some damage at Dharwar in 1909 and 1910. The grubs bore in the stem and produce a swelling and in the case of young plants they may be killed back, whilst older plants may break off in the wind at the point of attack. In the plants sent from Dharwar the swellings were in the roots or stem just below ground-level. This is the only occasion that we have had *Alcides collaris* sent in as a definite pest of *tur*.

Sphenoptera arachidis is occasionally found on *Cajanus indicus* in Southern India [see "South Indian Insects," pp. 298-299, figs. 141-142] but is scarcely a pest of this crop.

It occurs in small numbers at Coimbatore.

A few insects attack the roots of *tur*. Of these we know :—

Termites.
Gonocephalum elongatum.
Gonocephalum depressum.

Termites of various species attack roots of *Cajanus indicus* as of most other plants. I saw rather a good example of damage last year in Assam. About half-way up the road from Gauhati to Shillong there is a small estate where *Cajanus indicus* is grown as a host-plant for the cultivation of Lac, and the most serious pest they have to contend with is a large termite—an *Odontotermes* of the *feæ* group, probably *O. parvidens*, Holmgr.—which attacks the roots and kills the plants back to

a considerable extent. I show you a specimen of the roots (*exhibited*) and you can see how they are all eaten away. This termite is not a mound-builder, so that its control is difficult, and a deterrent, such as Crude Oil Emulsion or phenyle, seems the only remedy, but it is not easy to keep on applying such remedies to a semi-permanent crop of this kind.

Mr. Jhaveri. In the Bombay Presidency, *tur* plants are attacked by a fungal disease and afterwards by termites.

Mr. Fletcher. Yes, of course termites will come in and eat the decaying or dead wood. But, except in the case I have just mentioned, I do not think they are very troublesome to healthy *tur* plants.

Mr. Ramachandra Rao. *Margarodes niger* (Coccidæ) is found on the roots of *tur* plants at Hadagalli in the Bellary District. It does no damage.

Mr. Fletcher. Yes, this is a curiosity rather than a pest, I think.

Any more pests of *Cajanus indicus?* Then we will go on to

SOY BEAN (*Glycine hispida*).

We will take first the insects found feeding on the leaves. We have :—

Giaura (Cletthara) sceptica.
Diacrisia obliqua.
Plusia orichalcea.

Giaura sceptica seems to be a sporadic minor pest of this crop and velvet bean, on which it has been reared at Pusa and Surat, but it is not common as a rule.

Diacrisia obliqua attacks Soy-bean sometimes in large numbers and may do serious damage.

Mr. Ghosh. It is a very serious pest on the leaves.

Mr. Fletcher. We will discuss it later on under "Jute."

Plusia orichalcea also occurs on Soy-bean but is not generally bad on this crop.

Mr. Jhaveri. *Amsacta moorei* is a serious pest at Nadiad.

Mr. Fletcher. On the young leaves and shoots we also get *Aproærema* (*Anacampsis*) *nerteria*, which we will discuss under "Groundnut."

Of insects boring the stem we have :—

Nupserha bicolor.
Sphenoptera sp.

Nupserha bicolor has been found in Bihar, at Sabour and Pusa. The egg is laid on young plants, the beetle girdling a shoot. The larva bores down to the root and goes from one branch to another, killing the plant. The larva hibernates in the stumps. Control measures include destruction of affected shoots and of stumps after harvest.

Sphenoptera. We have *Sphenoptera* recorded as boring in Soy-bean at Nagpur, but it seems rather doubtful whether the species concerned is *arachidis* or *gossypii.*

Sphenoptera occurs as a stem-borer in Soy-bean at Nagpur and Tharsa.

Riptortus linearis and *R. pedestris* are bad on the pods in Assam.

The next crop is

GRAM (*Cicer arietinum*).

There are a good many insects which attack the young plants especially :—

Agrotis ypsilon.
Agrotis flammatra.
Prodenia litura.
Cirphis loreyi.
Zizera otis ?.
Chrotogonus.

Agrotis ypsilon is an important pest of gram in some localities, especially on the *tal* lands along the Ganges, as around Mokameh. I said something about this yesterday and full accounts of the work done on it have been published in the " Agricultural Journal of India " and the " Bihar Agricultural Journal," so we need not traverse all that ground again. About the only new point that I need mention is the large number of eggs, well over two thousand, which may be laid by the female moths. This makes it the more important to catch as many females as possible and this can be done by means of the Andres-Maire trap.

I may mention that I have had some of these traps made here and will be glad to let any Provincial Assistants have one on loan for trial.

In Bihar *Agrotis ypsilon* is the chief trouble in low lands.

An *Agrotis*—I do not know the species—does serious damage to this crop in Panch Mahals.

In Assam *Agrotis ypsilon* occurs in gram fields.

At Pusa both *Agrotis ypsilon* and *A. flammatra* occur in young gram fields in numbers.

We will take *Agrotis flammatra* next. It occurs throughout Northern India, Pusa being apparently its most southern limit so far as our records go. As a pest, it is minor and sporadic in most localities, but is stated to be a serious pest of gram and almost all low-growing plants in the spring at Lyallpur and throughout the Punjab. It is common in the North-West Frontier Province also. It is not attracted to Andres-Maire traps in any numbers, so far as I know, so some other control-method requires to be worked out. Judging by the sudden appearance

Agrotis ypsilon, Rott.

Fig. 1 shows a caterpillar hiding during the daytime under the soil near the base of cut plants, the earth being removed to expose the caterpillar;

Figs. 2 and 3 show the larva (enlarged);

Fig. 4 is a larva pupating in pupal chamber;

Fig. 5 is the pupa;

Figs. 6, 6 are moths resting during the daytime;

Figs. 7 and 8 are moths (drawn enlarged) in resting and flying attitudes.

Outline figure shows the natural size.

AGROTIS YPSILON

CHLORIDEA (HELIOTHIS) OBSOLETA (ARMIGERA)

Heliothis (Chloridea) obsoleta, Fb.

Fig. 1, An egg laid on a *tur*-pod (magnified);
Figs. 2-5, Caterpillars on a gram plant, two eating into the pods (life-size);
Fig. 6, Pupa in its underground cell (life-size);
Fig. 7, Moth in repose (life-size);
Fig. 8, Moth with wings expanded (life-size).

and disappearance of this species in large numbers, it would seem that it may be a migrant, as we suspect to be the case in *Agrotis ypsilon*.

Prodenia litura occasionally occurs on gram, chiefly in South Bihar, but is not a general pest of gram.

Cirphis loreyi has been recorded as found on gram leaves at Jubbulpur, but apparently nowhere else.

A *Zizera*, probably *Z. otis*, occurs on gram, but is not a pest. It is usually found on the flowers.

Chrotogonus, probably of various species, attack young plants especially. Bag-nets provide a simple form of control.

A few insects attack the pods :—

Heliothis obsoleta.
Plusia nigrisigna.
Liogryllus bimaculatus.

Of these *Heliothis obsoleta* is much the worst pest. In some districts in the North-West Frontier I understand that it is impossible to grow gram on account of an insect which attacks it and it would appear that this insect is *H. obsoleta*. In the Central Provinces also *H. obsoleta* is especially bad as a pest of gram. We have issued a coloured plate showing its lifehistory and this shows not only the various colour forms in which the caterpillars may appear but also the peculiar method of feeding, the caterpillar biting a hole in the gram-pod and feeding with its head inside and half its body outside. As regards control, this habit of feeding and the wide range of alternative food-plants make control difficult. In the case of young plants, bagging with a bag-net may be tried, but it is chiefly on the older plants, in the pod stage, that the caterpillars occur. Spraying is hardly practicable on a field-scale and is of little use when the caterpillars are eating into the pods. Fields which have been badly infested with the larvæ should be ploughed immediately after harvest to destroy the pupæ in the soil and prevent the resulting moths from ovipositing on other crops.

Heliothis obsoleta is a bad pest in the United Provinces. **Mr. David.**

In Madras *H. obsoleta* is an important pest. **Mr. Ramakrishna Ayyar.**

In Assam it occurs in gram-fields. **Mr. Gupta.**

In Panch Mahals it does serious damage to gram. **Mr. Jhaveri.**

It is not very bad in the Punjab. **Mr. M. M. Lal.**

Plusia nigrisigna is a sporadic minor pest of gram in Northern India. **Mr. Fletcher.** We have records of it on gram from Lyallpur, Cawnpur and Pusa. It bores the pods occasionally but is perhaps more often found on the leaves.

Liogryllus bimaculatus may sometimes do considerable damage to gram-pods by eating out the contents. I have here a photograph (*exhibited*) showing some pods eaten out by these crickets. We found them common in the gram-fields here and found that they seemed to prefer a mixed animal and vegetable diet, feeding partly on caterpillars and partly on gram pods. You will find a note on this habit in the Bulletin of Short Notes issued last year. On the one hand, therefore, the crickets do a great deal of good by catching and devouring the caterpillars feeding on the gram and on the other hand they must themselves plead guilty to doing direct damage to the crop. At present I should not like to say whether they do more good than harm. The photograph clearly shows the damage done. The case is rather parallel with that of blister-beetles which damage crops but do good by destroying grasshoppers' eggmasses.

I have a record of a weevil, *Tylopholis ballardi*, damaging the stems of gram-plants in the Bellary District. It has recently been described by Dr. Marshall in his "Fauna" volume on weevils, volume I, page 158. He merely says that "it was attacking the stems of Bengal gram" but I do not know what damage is done or whether by the beetle or its larva.

The adult beetle damages the plants in Bellary by gnawing and scraping the stem.

Gonocephalum elongatum has been found at Pusa and *G. depressum* in Bundelkhand, in the larval state in both cases, at roots of gram, and probably do some damage by feeding on the roots, but these are insects that we really know very little about.

In Nagpur Termites damage this crop in patches.

At Padu Farm, in Burma, Termites and cockchafer grubs do serious damage to this crop. No remedial measures have been tried.

The next crop is

MUNG (*Phaseolus mungo radiatus*).

[*Mung*—Hind. Green Gram in Madras.]

and with this we will take :—

URID (*Phaseolus radiatus*)

as the pests of both are practically the same.

On the leaves we get :—

Azazia rubricans.
Nacoleia indicata.
Plusia peponis.
Plusia chalcytes.
Plusia daubei.

Diacrisia obliqua.
Herse convolvuli.
Prodenia litura.
Colemania sphenarioides.
Anarsia ephippias.
Gnathospastoides rouxi.

Azazia rubricans. This is described and figured in "South Indian Insects" (p. 389, fig. 254). It is a minor, sporadic pest in Bihar and Madras. Control by hand-picking of larvæ and cultivation after harvest to destroy pupæ.

Mr. Ramakrishna Ayyar. It occurs on the leaves throughout the Madras Presidency.

Mr. Fletcher. *Nacoleia indicata.* This is described and figured in "South Indian Insects" (pp. 433-434, fig. 309). It has been reared at Pusa on *urid* and is probably a minor pest of *Phaseolus* throughout India.

Plusia chalcytes occurs throughout India but is a very minor pest of *Phaseolus* as a rule.

Diacrisia obliqua does great damage to leaves of *Phaseolus* in Bihar and Bengal.

Mr. Ghosh. It is the most important of all the leaf-eating pests in Bihar.

Mr. Fletcher. We will come to it later on under "Jute."

Herse convolvuli. This is described and figured in "South Indian Insects" (pp. 401-402, fig. 272) and we have since issued a coloured plate showing the lifehistory. It has been reared on *mung* at Samalkota and on *urid* at Kendrapara, in Orissa. It is an occasional minor pest of *Phaseolus.*

Prodenia litura (described and figured in "South Indian Insects," p. 377, tab. 19) has been reared from *urid* at Pusa.

Mr. Ghosh. Next to *Diacrisia obliqua* this is the most important leaf-eating pest of *urid* and *mung*. The caterpillars require to be tackled by hand-picking whilst they are young and are still gregarious.

Mr. Fletcher. *Colemania sphenarioides* ("South Indian Insects," p. 527, tab. 48) attacks *Phaseolus* together with various other crops in the Bellary District and in Mysore.

Anarsia ephippias was reared at Nagpur on *urid* in August 1910, and also at Pusa on *urid* topshoots and boring pods of *mung*.

Mr. Shroff. There is a small caterpillar, I am not certain whether it is *Anarsia*, which bores the topshoots of *urid* at Mandālay.

Mr. Fletcher. *Gnathospastoides rouxi* ["South Indian Insects," p. 302, fig. 147] has been found on *urid* leaves at Pusa but is scarcely a pest.

The sucking insects on *urid* and *mung* include :—

Coptosoma cribraria.

Riptortus pedestris.
Nezara viridula.
Anoplocnemis phasiana.
Aphids.

None of these are specific pests or of regular occurrence as pests of *Phaseolus* so that they only require mention here.

Aphids occur on shoots of *mung* in Madras.

Aphids occur on this crop in Mandalay also.

In Jalgaon we get Aphids and *Nezara*.

Some insects attack the seeds of *mung* and *urid* :—

Pachytychius mungonis.
Maruca testulalis.
Agromyza sp.
Catochrysops cnejus.

Pachytychius mungonis. This is the species described and figured in "South Indian Insects" [p. 336, fig. 194] under the name of the "Green Gram Weevil." It is apparently only known in Madras up to the present. Is there anything new to add about it in Madras ?

It has been observed attacking pods of green gram in Coimbatore, Bellary, and Kurnul.

Maruca testulalis and *Catochrysops cnejus* we have already discussed under *Cajanus indicus*. Both occur regularly on *mung* and *urid* and do some damage.

In a small plot of *mung* in the Pusa Insectary Compound, all the pods were destroyed by *Catochrysops*.

Agromyza sp. This is figured and described in "South Indian Insects" [p. 358, fig. 217]. It destroys young *mung* plants in Madras, but does not seem to have been noticed elsewhere.

Boring in the stem of *mung* and *urid* :—

Alcides collaris.
Oberea sp.

Alcides collaris ["South Indian Insects" p. 337, fig. 195] was found on green gram at Hadagalli and occurs in this crop as a minor pest in Madras.

Oberea sp. Will you tell us something about this, Mr. Ghosh ?

This longicorn borer occurs regularly on *mung* and *urid*. A portion of the stem is ringed at two places, at a distance of about an inch or so from one another, and the egg is thrust into this ringed portion. The whole stem above the lower ring withers and is easily noticeable. The larva bores in the stem and pupates there. Some of the larvæ have been observed to rest for the whole year.

Can you tell us anything about the amount of damage done and any control method applicable? **Mr. Fletcher.**

The damage done on the whole is not very much—not sufficient to call for remedial measures, so far as I have observed. **Mr. Ghosh.**

Apparently this insect has only been noticed at Pusa. **Mr. Fletcher.**

The next crop is

MOTH (*Phaseolus aconitifolius*).

Its pests are probably very similar to those of the other species of *Phaseolus*, but we do not seem to have so many insects noted, probably because *moth* is grown to a smaller extent in this district.

Leaf-eating pests :—

Plusia chalcytes.
Prodenia litura.
Amsacta moorei.
Anarsia ephippias.

Plusia chalcytes occurs occasionally in most districts but is not much of a pest as a rule.

Prodenia litura occurs as a minor pest in most districts.

Anarsia ephippias has been reared from *moth* leaves and topshoots at Pusa but is quite a minor pest.

Amsacta moorei occurs as a pest of *moth* in the Punjab. Perhaps Mr. Madan Mohan Lal will tell us about it?

Amsacta moorei is a sporadic major pest of pulses in the Eastern Punjab. In Jagadhari, Ambala District, it attacked the *moth* crop seriously in July and August 1914. Light-traps were used and found successful, nearly 5,000 moths being collected in a fortnight. This pest was bad in 1913 also, but nothing was done last year to control it. **Mr. M. M. Lal.**

In what stage was the crop attacked? **Mr. Fletcher.**

The plants were still young. **Mr. M. M. Lal.**

When were these light-traps used? **Mr. Fletcher.**

From 5th to 17th July. **Mr. M. M. Lal.**

Amsacta moorei occurs on *moth* in North Gujarat also. **Mr. Jhaveri.**

The next crop is **Mr. Fletcher.**

LABLAB (*Dolichos Lablab*).

[*Sem*—Hind. *Val*-Gujarat. *Shima*-Bengal.]

We have a long list of insect pests of this crop, but many are the same as those we have already had on other pulses.

The seedlings are sometimes attacked by termites, as is the case in many other crops.

Termites damage the seedlings at Mandalay. Crude Oil Emulsion has been tried, with good results, but all the seeds did not germinate.

Adisura atkinsoni also attacks the seedlings at Coimbatore.

On the leaves we get a few pests :—

Diacrisia obliqua.
Amsacta moorei.
Acherontia styx.
Platypria hystrix.
Episomus lacerta.

Diacrisia obliqua does considerable damage in districts where it occurs, especially in Bihar and Bengal.

It occurs on *lablab* in Burma also.

Amsacta moorei also occurs as a pest in some districts, especially in Gujarat. Mr. Jhaveri, will you tell us about your work on it ?

Amsacta moorei is very bad on *lablab* seedlings in Northern Gujarat. We make trenches round about the infested plots and put in the trenches the leaves of a kind of Prickly Pear.* The caterpillars are attracted to these leaves and can be killed there.

Where do you get these Prickly Pear leaves ?

The Prickly Pear is grown as a hedge plant.

If Prickly Pear is preferred by the caterpillars, why do they attack the *lablab* instead of remaining in the hedges ?

If they eat both, there is no reason why they should not attack the *lablab* as well.

Probably these Prickly Pear leaves in the trenches attract the larvæ which fall into the trenches by providing shelter and so act as traps.

To protect the *lablab* fields light-traps have also been used. In 1911 twenty light-traps were used and 22,500 moths were caught. In 1912 strong Kitson lamps were used and 12,840 moths were attracted, of which 6,663 were males and 6,177 were females. In 1913 ordinary lamps were used and 8,336 moths were caught, of which 761 were females and 7,575 were males ; the Kitson lights were placed at a height of four or five feet from the ground and the traps were put on the ground. In 1914, 9,062 moths were collected, of which 7,330 were males and 1,732 were females. In 1915, 1,551 moths were caught, of which 1,234 were males and 317 females. In 1916, 1,175 moths were caught, of which 919 were males and 256 were females. When stronger lights were used, the proportion of females was higher. The total number of eggs in one female is about 700.

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*I have since seen this so called "prickly pear" at Surat. It is not an *Opuntia* at all but is an Euphorbiaceous plant. T. B. F.

In the beginning of the experiments, in 1911, a large number of moths was trapped, but in spite of such a large catch, the caterpillars did attack the Farm crops. This shows that light attracts the moths from distant places also. When the traps were continued, the attack decreased in severity from year to year.

Bagging was also tried on Cotton and Sann-hemp grown for green-manuring and was found very effective in the latter case.

Handpicking of moths was also tried in the mornings and evenings but it was not very successful.

At what time of year do you get damage done to crops ? **Mr. Fletcher.**

The worst outbreak occurs in June and July. It is the first brood which is always bad. **Mr. Jhaveri.**

That is not in agreement with our experience in Madras. There the moths emerge in a similar way after the first showers of the monsoon but there are relatively few caterpillars from this lot ; it is the second and often more especially the third brood of caterpillars which occur in such large numbers and do damage. If the first brood is checked by hand-picking, little damage follows later on as a rule. Of course, the broods run into one another, but roughly that is what happens. **Mr. Fletcher.**

In Mysore, in the case of *Amsacta albistriga*, it has been noticed that hardly any females were attracted to light-traps. There hand-collecting of the moths is successful and it has been suggested that local legislation should be introduced whereby a cess would be levied on the cultivated areas where this insect does damage and the money paid back to the villages for collection of the moths by children, at the rate of $\frac{1}{4}$ anna for each dozen moths collected. **Mr. Kunhi Kannan.**

In Bellary, *Amsacta albistriga* occurs in larger numbers than *A. moorei*, but in South Arcot both species occur in about equal numbers. **Mr. Ramachandra Rao.**

Amsacta albistriga and *A. moorei* are often found coupled. Have you reared any hybrids ? **Mr. Fletcher.**

No ; none have been reared as yet. **Mr. Ramakrishna Ayyar.**

Mr. Madan Lal, you told us just now that you had used light-traps successfully in the Punjab to control *Amsacta moorei* on *moth*. Can you tell us the proportions of the two sexes in the moths attracted to your traps ? **Mr. Fletcher.**

Roughly half were males and half females. **Mr. M. M. Lal.**

The great differences in the effect of light-traps as control measures, both as regards the total number of moths attracted and the proportion of the sexes in various localities, is very noteworthy. **Mr. Fletcher.**

Acherontia styx [" South Indian Insects," p. 402, tab. 24] occurs in most localities as a minor pest of *lablab*. The larvæ may be hand-picked, but are not always easy to see.

At Coimbatore *Acherontia styx* is found on the leaves of *lablab*.

Platypria hystrix [" South Indian Insects," p. 316, fig. 167] occurs on *lablab* sometimes but is scarcely a pest.

Episomus lacerta ["South Indian Insects," p. 327, fig. 184] has occurred in some numbers on *lablab* at Coimbatore.

At Coimbatore we get a leaf-miner in *lablab* also.

That will be *Cyphosticha cœrulea*, of which we have records as mining *lablab* leaves at Coimbatore and Pusa. It is probably widely distributed and may do a small amount of damage at times.

Next, we get shoot-borers in *lablab* and of these we have :—

Laspeyresia torodelta
Sagra nigrita.

Laspeyresia torodelta, described and figured in " South Indian Insects," p. 451, fig. 329, is apparently confined to Southern India, where the larva bores the shoots, especially of young plants. The affected top-shoots should be picked off.

Sagra nigrita (Chrysomelidæ) has not been found in India, so far as I know, as a pest of *lablab* but in 1909 Mr. Green found the larva boring into *lablab* stems in Ceylon and apparently doing some damage. The species occurs commonly in India, so I draw your attention to it.

Alcides collaris bores the stems at Coimbatore.

Sphenoptera occurs at Nadiad.

In the pods and seeds of *lablab* we get a good many pests most of which are identical with those already noted in *tur* and other grams :—

Adisura atkinsoni.
Heliothis obsoleta.
Catochrysops cnejus.
Polyommatus boeticus.
Maruca testulalis.
Sphenarches caffer.
Exelastis atomosa.
Agromyza sp.

Adisura atkinsoni seems to occur chiefly in Madras as a pest of *lablab*, the larvæ boring into the pods and usually occurring every year in January and February.

Adisura atkinsoni is rather bad in Madras, on *lablab*.

Have you worked out its lifehistory ?

The pupa remains in the soil from February until October-November.

In that case cultural methods are indicated to kill the pupæ before sowing the next crop. **Mr. Fletcher.**

The other insects on the list as attacking pods and seeds have already been mentioned under gram and *tur*, and I do not think that they call for any further remarks now, unless anyone has anything more to say.

A species of *Bruchus* occurs at Coimbatore on *lablab*, and attacks the crop whilst it is still in the field. The eggs are laid on pods in the field, in masses of about ten. This *Bruchus* is different to that found on *Vigna catjang*. **Mr. Ramachandra Rao.**

A few sucking insects occur on *lablab*, but these again are mostly identical with those we have already discussed on other crops :— **Mr. Fletcher.**

Coptosoma cribraria.
Clavigralla gibbosa.
Riptortus pedestris, etc.
Aspongopus janus.
Aphids.

As regards the bugs, collection by handnets (for *Coptosoma*) or by hand, or by shaking them off the plants into vessels should suffice for control. Aphids require spraying but this is hardly practicable on a field scale ; Aphids seem to be worst on this crop in Madras, Burma and Gujarat.

Ceroplastodes cajani is rather bad on the stems at Coimbatore. **Mr. Ramakrishna Ayyar.**

The next crop is **Mr. Fletcher.**

HORSE GRAM (*Dolichos biflorus*). [*Kulthi*-Hind.]

On the leaves we get larvæ of
Estigmene lactinea,
Nacoleia indicata,
but neither of these calls for particular comment.

On the pods we find
Etiella zinckenella.
Bruchus chinensis.

Of these *Bruchus chinensis* occurs at Pusa on stored seeds only.

Boring in the stem of *Kulthi* we have :—

Sphenoptera arachidis.
Alcides fabricii.

Sphenoptera arachidis seems to occur chiefly in Madras and *Alcides fabricii* was found at Hadagalli, in the Bellary District. In both cases, destruction of attacked plants is the only thing to do.

The next crop is

KHESARI (*Lathyrus sativus*).

On this we find *Plusia* larvæ on the leaves as sporadic minor pests, and larvæ of *Etiella zinckenella* attacking the pods, especially in Bengal, where *Etiella* is a sporadic pest of this crop.

Etiella is a bad pest of *khesari* in Bengal. The caterpillars eat the seeds inside the pods, there being practically no external symptom of damage.

Has anyone anything more to add ?

When the crop is harvested the caterpillars are brought into the farmyard with the pods but soon leave the pods and wander about and may be collected in numbers and destroyed at that time.

That seems rather late in the day, but it helps to reduce the number of the species as regards leguminous crops later on.

In Broach *khesari* is being grown on a large scale. This year a caterpillar has been reported to do serious damage to the pods ; I am not sure of the identity of the insect, but it may be *Etiella*.

The next plant is

SWEET PEA (*Lathyrus odoratus*).

It is not exactly a crop, but is extensively grown in gardens and you may be called on to deal with pests on it and also it belongs to the same genus as *khesari* and acts as an alternative foodplant for many of these pests of regular leguminous crops ; so we will consider it here.

The leaves are sometimes attacked by *Diacrisia obliqua* larvæ, which feed on practically any low-growing crop.

Diacrisia obliqua occurs on sweet-pea leaves at Dacca.

In the pods we find larvæ of
Heliothis obsoleta,
Etiella zinckenella.

Probably *Catochrysops cnejus* and *Polyommatus boeticus* also occur in the pods. but we do not seem to have any definite records of either.

Heliothis obsoleta and *Etiella zinckenella* are both pretty common and sometimes do some damage when it is required to collect seeds for the next sowing.

Etiella was noted at Sabour in sweet-pea pods.

Aphids also occur at Sabour on sweet-pea.

Aphids occur at Pusa also but do not seem to do much harm as a rule.

At Pusa the sweet-pea Aphid is attacked by a fungus (*Entomophthora*) which exercises some check on the Aphid. **Mr. G. R. Dutt.**

Cow-pea (*Vigna catjang*).

Cow-pea seedlings are attacked by the larva of an *Agromyza*, which is described and figured in "South Indian Insects" [p. 358, fig. 217]. It is a serious pest of young plants and was bad at Pusa in August 1915. **Mr. Fletcher.**

At Sabour the maggots were found high up in the stem of cow-peas. **Mr. H. L. Dutt.**

At Pusa they are found just near or below the soil-surface. **Mr. Ghosh.**

It may be that more than one species is concerned. As regards control, in either case, I do not think that we can suggest anything at present. **Mr. Fletcher.**

A good many insects attack the leaves of cow-pea :—

Laphygma exigua.
Azazia rubricans.
Prodenia litura.
Plusia orichalcea.
Colemania sphenarioides.
Pogria signata.
Epilachna spp.

Laphygma exigua is a sporadic pest in most localities. Control is difficult owing to the short lifehistory and consequent rapid rate of increase and also to the wide range of food-plants. It is possible that control may be possible with Andres-Maire traps or on similar lines but experiments are required.

Azazia rubricans is a minor sporadic pest of cow-pea, as of other pulses, in Bihar and Madras.

Prodenia litura is sometimes found on cow-pea but is hardly a regular pest of this crop.

Plusia orichalcea is also an occasional minor pest.

Colemania sphenarioides attacks cow-pea together with other crops in Bellary and Mysore but is principally a pest of cereals.

Pogria signata is a Chrysomelid beetle which seems to occur as a pest of cow-pea principally in Assam. In September 1913 it was reported to have completely destroyed about four *bighas* of cow-peas grown for seed. We have examples from Pusa and the Nilgiris also, so that it is evidently widely-distributed and may turn out to be a sporadic pest.

Epilachna spp. also occur on cow-pea at Pusa but do not do much damage as a rule.

On the flowers of cow-pea we get *Zonabris pustulata* and probably a good many other species of Meloidæ. They are easily collected by hand or in small nets when abundant and doing damage.

A *Sphenoptera*, perhaps *S. arachidis,* sometimes bores in the stems of cow-pea, but we seem to know very little about it, so it is probably unimportant.

In the seeds of cow-pea we find a few insect pests, mostly similar to those attacking other pulses :—

Pachytychius mungonis.
Bruchus chinensis.
Catochrysops cnejus.
Maruca testulalis
Etiella zinckenella.

Pachytychius mungonis is described and figured in "South Indian Insects," pp. 336-337, fig. 194, under the name of the "Green Gram Weevil." It seems to be confined to cow-pea and *mung* and so far is only known in Southern India.

Bruchus chinensis has been found in cow-pea pods at Nagpur, but we do not know what damage it does to this crop in the field.

Another species of *Bruchus* occurs in cow-pea pods in the field at Coimbatore. It is different to the species which attacks Lablab seeds.

There seem to be a good many different Bruchids doing damage in India, both to crops in the field and to stored seeds, and we require to work them out systematically before we shall be able to do much in the way of control at least as regards the crops in the field.

Catochrysops cnejus and *Maruca testulalis* also attack cow-pea pods but we have already considered these species and there is nothing special to add as regards cow-pea.

Then there are a few sucking insects found on cow-pea, and amongst these we may mention

Riptortus spp.
Aphids.

Neither of these is peculiar to cow-pea and ordinary control methods are applicable.

CLUSTER BEAN (*Cyamopsis psoralioides*).

[*Guar*—Hind.]

The flowers of cluster-bean are attacked by a gall-fly at Coimbatore. Perhaps Mr. Ramachandra Rao will tell us about it.

A gall-fly was found attacking the flowers of cluster-bean in the Insectary garden at Coimbatore. It has not yet been noticed in this

crop in the field. The damage done is very similar to that done to gingelly and the fly appears to be the same.

Mr. Fletcher. That is the Cecidomyiad called the "Gingelly Gall-fly" in "South Indian Insects," p. 364, fig. 224. It has since been described by Dr. Felt and named *Asphondylia sesami*. If it is the same species, it is interesting to find that it has an alternative food-plant like this.

. On the leaves and shoots of cluster-bean we get :—

Dichomeris ianthes.
Diacrisia obliqua.
Blosyrus inæqualis.
Astycus lateralis.

Dichomeris ianthes, also called *Ypsolophus ochrophanes* in Indian economic literature, is a minor pest of cluster-bean, sporadically doing some damage. It is described and figured in "South Indian Insects" [pp. 456-457, fig. 332], but the figure is a poor one and we have shown the stages in a new coloured plate, which I now show you. Its occurrence on cluster-bean is mostly of importance as this crop acts as an alternative food-plant in places where indigo and lucerne, to which it is sometimes destructive, are grown.

Diacrisia obliqua is a sporadic pest of cluster-bean, chiefly in Bihar and Assam. Doubtless other Arctiad larvæ (*Amsacta*, etc.) also occur on this crop, but we seem to have no exact records.

Blosyrus inequalis, a Curculionid beetle, was found on cluster-bean at Hadagalli, and *Astycus lateralis*, another weevil, at Pusa, but neither is of any importance.

Boring in the stem of cluster-bean we have *Alcides bubo* recorded from Villapuram and South Kanara, but it is not much of a pest so far as we know.

Amongst sucking insects on cluster-bean we get :—

Coptosoma spp.
Aphids
Mites.

Coptosoma is probably of minor importance as a pest and, when it occurs, is best controlled by hand-nets. Aphids and Mites sometimes do some damage.

Mr. Jhaveri. Aphids occur on *guar* at Nadiad, in North Gujarat, and Mites are very bad on this crop in Gujarat.

Mr. Fletcher. Any control measures tried ?

Mr. Jhaveri. Dusting with Lime and Sulphur has been tried and found successful.

The next crop is

BAKLA (*Vicia faba*).

We seem to have no pest definitely noted on this.

A Stemfly is found in the Chanda District of the Central Provinces.

The next crop on my list is

LENTIL (*Lens esculenta*). [*Masur*-Hind.]

Here again we have no pests definitely recorded. Does anyone know of any ?

An Aphid is very serious in the Northern districts of the Central Provinces—Jubbulpur, Mandla, Bilaspur, and Raipur. It is kept in check by *Coccinella septempunctata.*

Liogryllus bimaculatus also attacks the pods and eats the seeds. These insects are so abundant in one particular village that it has been called Jhingari, meaning "full of crickets." As regards control, heaps of *masur* plants are put down here and there in the fields and the crickets are attracted to these and can be killed there.

The next crop is

PEA (*Pisum sativum*).

[*Matar*—Hind.]

Pea seedlings are attacked by

Agromyza sp.

Agrotis flammatra.

As regards *Agromyza* the young seedlings are attacked by larvæ which tunnel in the stem and often do serious damage by killing off a large proportion of the young plants. Mr. Ghosh, will you tell us something about it ?

The pea stem *Agromyza* has been under observation for the last few years at Pusa and in the neighbourhood. It attacks seedlings mostly and damages grown-up plants only occasionally and to a much less extent. It attacks both *Pisum sativum* and *Pisum arvense* but in some years one is attacked badly and in other years the other is similarly bad. I am not in a position to explain the reason why sometimes one crop is attacked and sometimes another. The attack has been observed to be so bad as to destroy whole fields. Unfortunately the attack cannot be detected until after the damage has been done.

I have found tobacco decoction useful against a leaf-mining *Agromyza.* Perhaps it might do in this case.

But the pea *Agromyza* is not a leaf-miner. The maggot works just near or even below the soil-surface and under the bark of the stem,

chewing the tissue all round the woody part; as a result, the whole plant withers.

Would it be possible to irrigate and apply a deterrent in the irrigation water? **Mr. Fletcher.**

Peas are not irrigated crops. Irrigation with Crude Oil Emulsion and Sanitary Fluid Water was tried but without definite results. When the withering plants are earthed up and watered they throw out fresh roots from above the chewed up parts and live but are sickly and hardly bear. **Mr. Ghosh.**

Growing peas with other crops has been tried and this year's experiments are rather interesting :—

A { 1. *Pisum sativum* was grown alone but the crop was thin.
  { 2. *P. sativum* was grown intermixed with *Vicia faba*.

B { 3. *P. sativum* was grown intermixed with barley.
  { 4. *P. arvense* was grown alone and the crop was thin.

All plants were destroyed in (1), a few destroyed in (2), none destroyed in (3) and (4).

Were these plots close to one another? **Mr. Andrews.**

Plot (1) was contiguous to (2) and plot (3) was contiguous to (4). A about 70 feet from B. Pea is usually grown as a mixed crop. **Mr. Ghosh.**

What is your experience with this pea-stem *Agromyza* in Bihar, Mr. Dutt? **Mr. Fletcher.**

Where rotation is not practised, the attack is very bad. Such has been the case at Sabour in the Botanical area, where peas are grown year after year in the same plot. On the Farm, where rotation is practised, very few plants are damaged. **Mr. H. L. Dutt.**

Any further remarks on this insect? **Mr. Fletcher.**

The pea stem fly occurs in Bengal also. **Mr. P. C. Sen.**

We will go on to the next insect. *Agrotis flammatra* sometimes damages pea seedlings in the Punjab. **Mr. Fletcher.**

It occurs throughout the Punjab. There is no definite control so far. **Mr. M. M. Lal.**

We will go on to the leaf-eating insects found on the pea plant :— **Mr. Fletcher.**

Plusia orichalcea.
Prodenia litura.
Diacrisia obliqua.
Monolepta signata.
Hypera medicaginis.

Plusia orichalcea is not confined to pea but sometimes does considerable damage. We have shown the stages on a new coloured plate which is placed on the table. Spraying and hand-picking may be done in garden plots but are not practicable on a field scale.

Dragging a rope, moistened with kerosine and turpentine, over the crop drives away the caterpillars. Even if they go into the neighbouring fields, the crop is saved.

Plusia orichalcea occurs on pea in Bengal also.

Prodenia litura and *Diacrisia obliqua* are both sporadic pests of pea, attacking this crop along with any other low-growing vegetation that may be available.

Monolepta signata is recorded from the Patna District on pea but is scarcely a pest, so far as we know.

Hypera variabilis. The larva occurs on pea at Pusa, but has not been found as a pest so far.

Several insects attack the pods and seeds :—

Etiella zinckenella.
Polyommatus bœticus.
Bruchus chinensis.
Bruchus affinis.

Etiella we have already considered and need only just mention again now. It is not a very serious pest of peas as a rule.

Polyommatus bœticus occasionally occurs in some numbers, the larva boring into the pods and eating the seeds. It occurs all over India.

It is found in peas at Jorhat, in Assam.

Bruchus chinensis oviposits on the pods in the field, but the main damage in most districts seems to be done to the seeds after storage.

Bruchus affinis occurs in the fields to a small extent and does some damage.

As I said just now, we want to know a great deal more about these Bruchids—the distinctions between the various species and the habits of each, as the habits seem to vary a good deal.

As *Bruchus affinis* is rather a specific pest of peas and we have been doing some work on it at Pusa; I will ask Mr. Ghosh to give you a short account of what we have found out.

Bruchus affinis, although it is found in stored peas from July or rather August onwards, is really a field pest, as infection takes place in the field, the beetles laying eggs on the green pods. The grubs on hatching bore into the seeds and come into the store with the seeds. Most of the beetles on attaining the adult stage remain in the seeds and come out when the seeds are sown next year. Therefore before sowing seeds should be placed in water. Those which sink should be sown and those which float should not be sown.

Damage is prevented if the seeds are fumigated with Carbon Bisulphide before storing or if stored with Naphthaline in airtight vessels.

Plusia orichalcea, Fb.

Figs. 1 and 2, caterpillar, natural size and enlarged.
Fig. 3, pupa.
Figs. 4 to 6, moth, natural size and enlarged in different attitudes.
The small outline figures indicate the natural sizes.

PLUSIA ORICHALCEA.

But in the latter case the smell of the Naphthaline is retained even when the *dal* is cooked for the table.

The next crop seems to have no English name. It is :— **Mr. Fletcher.**

Pisum arvense. [*Desi matar*—Hind. *Kirao*—Bihar.]

As we noted just now under Pea, this crop is attacked by *Agromyza* when young and *Bruchus affinis* is also found in the seeds. Its pests are practically the same as those of Pea and call for no special comment.

The next crop is

SWORD BEAN (*Canavalia ensiformis*).

[*Bara Sim*—Hind. *Makkhan Sim*—Hind.]

On the leaves we get :—

Diacrisia obliqua.
Myllocerus dorsalis.

Of these *Myllocerus dorsalis* is a weevil which we have recorded on this crop at Kumbakonam, in Madras. It is not a regular pest, so far as we know.

Diacrisia obliqua larvæ attack Sword-bean in much the same way as they attack all low-growing crops.

Diacrisia larvæ are sometimes bad on the leaves in Burma. **Mr. Shroff.**

Attacking the pods of Sword-bean we get :— **Mr. Fletcher.**

Maruca testulalis.
Catochrysops cnejus.

and probably most of the other pod-borers we have noticed on other leguminous crops.

Maruca testulalis has been recorded from Assam but is not generally very common on Sword-bean.

Catochrysops cnejus occurs, probably in most districts, but does not do much damage as a rule.

It occurs in Burma, but not as a pest. **Mr. Shroff.**

The next crop is **Mr. Fletcher.**

SANN HEMP (*Crotalaria juncea*)

which is becoming an increasingly important crop in India in many districts where it is being grown for green manure. As it is a leguminous crop it is more convenient to take it here. We have a long list of pests, many of which do great damage.

The seedlings are attacked by

Chrotogonus spp.

Flea-Beetles,

and of course by *Utetheisa* and other insects which we shall come to under the heading of leaf-pests.

Chrotogonus, probably several species, attack the young seedlings. They may be dealt with by means of bag-nets.

Flea-Beetles are common pests on seedlings all over India and have been noted to do damage in Madras, Bombay, the Central Provinces, Bihar and Burma. This is a group in which we are at present very ignorant of the identity of the species, and I cannot say more than that several different species are probably concerned. Spraying in small plots or catching the beetles by means of nets will usually provide control.

On the leaves we get a good many pests :—

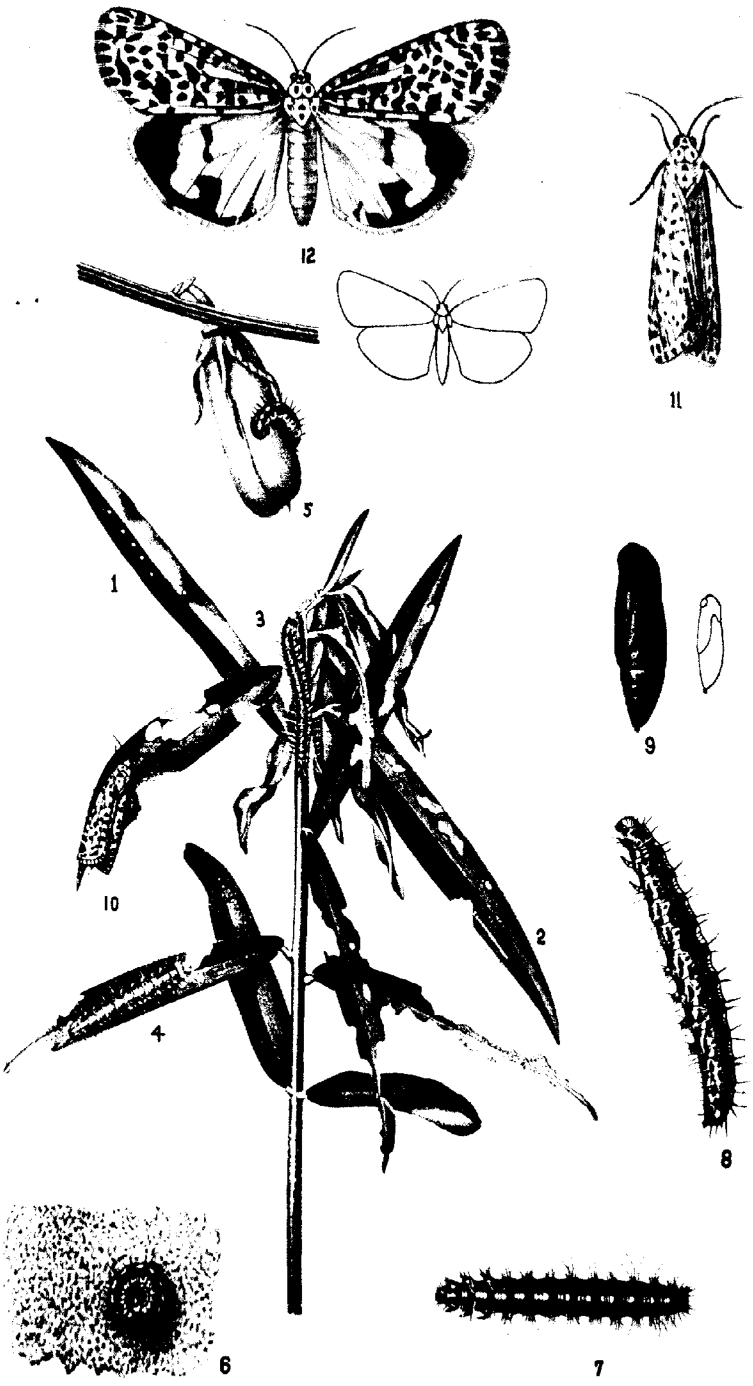
Utetheisa pulchella.
Argina cribraria.
Argina syringa.
Argina argus.
Amsacta moorei.
Plusia signata.
Euproctis scintillans.
Amyna octo.
Chaetocnema basalis.
Tanymecus indicus.
Myllocerus blandus.

Utetheisa pulchella is probably the most important pest of Sann-hemp in India and attacks not only the leaves but also the pods and seeds as well. It is figured and described in "South Indian Insects" [pp. 371-372, fig. 233] and we have since issued a coloured plate showing the stages.

Control is very difficult. In the case of small plots spraying and handpicking are of course useful and in the case of young plants bagging may collect a good many larvæ, but on a field scale with well grown plants, handpicking, bagging and spraying are alike impracticable. The moths themselves are active and cannot be checked by hand-nets or light-traps; they fly very actively by day and a few come in to light in the evening. The pupæ may occur in folded leaves on the plants or on the surface of the ground, and we practically cannot get at them whilst the crop is standing. At present I can only suggest two lines of work, both of which require investigation. One of these is an application of clean cultivation and rotation to try to check the insect by

Utetheisa pulchella, Linn.

Fig. 1, Eggs on a leaf;
Figs. 2-4, Caterpillars of various stages feeding on leaves;
Fig. 5, A caterpillar feeding on the seeds inside a pod;
Fig. 6, A caterpillar in curled-up position after falling on the ground from a plant;
Fig. 7, Caterpillar, dorsal view (magnified);
Fig. 8, Caterpillar, side view (magnified);
Fig. 9, Pupa;
Fig. 10, Moth in repose, natural size;
Fig. 11, The same magnified;
Fig. 12, Moth with wings expanded.
Figures in outline show the natural sizes.



UTETHEISA PULCHELLA

depriving it of foodplants, which include wild species of *Heliotropium* as well as *Crotalaria*; but it seems probable that any efforts in this direction would be foiled by the strong migratory abilities possessed by this insect, which is a well-known migrant, frequently reported as met with out at sea at great distances from the nearest land. The other line of investigation deals with its natural enemies in the way of parasites. It is possible that we may be able to find, and introduce where necessary, parasites to check *Utetheisa* as the caterpillar feeds quite exposed and should fall an easy prey, especially when it occurs (as it does on Sann-hemp) in enormous numbers. That is a thing in which you can all help by collecting large numbers of *Utetheisa* larvæ and seeing whether you can get any parasites; and, if so, we should like to know and to have specimens, alive if possible, to experiment with.

There does not seem much more to say about this species except to call your attention to the considerable range of variability exhibited by *Utetheisa pulchella*, both in the caterpillar and the moth. In both the markings seem extremely variable and we had some caterpillars, found at Pusa on *Heliotropium*, which we supposed to be something quite different; but they all turned out to be quite ordinary *Utetheisa*. As regards the moths, the largest range of variation seems to be shown in the Punjab, where in some cases the black markings of the forewing may be obsolete leaving the red markings strongly developed and coalescing to form crimson stripes and bars, and in other cases the red markings may have disappeared leaving the black markings only. I just mention this so that you may know what to expect if you come across specimens which do not exactly agree with the examples shown on our coloured plate of this species.

Utetheisa pulchella occurs in the Punjab on Sann-hemp as a pest and is found breeding on *Heliotropium* also. It occurs from March to September. **Mr. M. M. Lal.**

In Bengal it is checked by bagging, but this is only possible in small plots when the crop is young. **Mr. Sen.**

In the Central Provinces *Utetheisa* is generally found on "Ghunghuni." I do not know the botanical name but it is apparently closely allied to Sann-hemp. The cultivators are advised to eradicate this weed. As regards natural enemies, a bird, *Motacilla alba*, has been observed to feed on these caterpillars and the Pentatomid bug, *Canthecona furcellata*, is also predaceous on them. **Mr. Ratiram.**

In Burma *Utetheisa pulchella* occurs commonly on Sann-hemp. **Mr. Shroff.**

Argina cribraria ["South Indian Insects", pp. 400-401, fig. 270] occurs throughout India, Burma and Ceylon as a pest, often serious, of Sann-hemp, the larva devouring the pods and leaves much in the **Mr. Fletcher.**

same way as *Utetheisa*. In the case of young plants bagging with a net may be used to collect the caterpillars but in the later stages of growth, when the caterpillars are attacking the pods, this is impracticable and little can be done directly beyond hand-picking, but in some cases larvæ get right inside the pods and are not visible from outside. The moths themselves may be handpicked as far as possible, but are not easy to find in any number. Pupation may take place inside the pods, but more usually in a loose cocoon on the surface of the soil.

In Burma *Argina cribraria* and *A. syringa* both occur on Sann-hemp, but less commonly than *Utetheisa*.

Argina syringa [" South Indian Insects," p. 401, fig. 271] occurs principally in Southern India and Bombay as a minor pest of Sann-hemp, occasionally abundant and doing considerable damage. Around Poona, where Sann-hemp is grown as a green-manure crop, this insect is said to be a serious pest every year. As regards control, I do not think we can say any more than we have said already under *Argina cribraria*.

Argina argus occurs throughout India and Ceylon and the larva is occasionally found attacking Sann-hemp pods but it is scarcely a pest. However, as Sann-hemp becomes more commonly grown as a green-manure crop and larger quantities of seed are required for this purpose, I expect we shall hear more of *Argina argus* as a pest.

Amsacta moorei occurs in North Gujarat as a pest of Sann-hemp in common with other low-growing crops. We have already discussed control of this species. Does it occur in Madras as a pest of Sann-hemp ?

In Madras it has not been found to damage Sann-hemp.

Plusia signata. There is some doubt about the identification of this and perhaps *P. chalcytes* is the insect in question. It occasionally occurs on Sann-hemp, chiefly in Madras, but is scarcely a pest.

Euproctis scintillans [" South Indian Insects," p. 399, fig. 268] occurs sometimes on Sann hemp, but is a minor pest as a rule. Handpicking of the caterpillars and moths will provide control where required.

Amyna octo has been reared at Palur from larvæ on Sann-hemp and at Pusa from larvæ (green, with a white subdorsal stripe and only three pairs of prolegs) found feeding on Sann-hemp leaves. It is a minor pest and is generally very much parasitized, so that further control is not required.

Chætocnema basalis (Chrysomelidæ). I have this name on my list, but it has been taken from old records on cards as having occurred on Sann-hemp at Pusa in August 1905 and April 1906, at Raipur " a good deal " in August 1907, at Jullundur in September 1905, and at Surat in 1904. We do not seem to have any specimens, however, from

any of these localities, and it is possible that the identification may not be correct, and in the absence of specimens we cannot check it.

Tanymecus indicus and *Myllocerus blandus* are two weevils, which have been found on Sann-hemp at Pusa but are scarcely pests. *M. blandus* is commoner than *T. indicus.*

On the flowers of Sann-hemp we get Meloid beetles, as on other flowers, but when they do damage they are fairly easily caught in hand-nets.

In this connection I might mention that, when you come across Meloid beetles in numbers, it will be useful if you collect a good deal of material and dry it in order to experiment with these beetles as a source of Cantharidin for Veterinary purposes. In the "First Hundred Notes" I gave some figures of the amount of Cantharidin available in some species, but we want a good deal more information on the subject to know which are the best species to use and where they will be available as regards a regular supply.

We find a few insects boring in the shoots and stems of Sann-hemp :—

Laspeyresia pseudonectis.
Laspeyresia tricentra.
Sphenoptera arachidis.
Nupserha sp.

There has been a good deal of confusion between these first two species and the plate used in "Indian Insect Life" and "South Indian Insects" is very poor. I have therefore had a new plate done of *L. pseudonectis* and the original of this is laid on the table for you to see. You will see that *pseudonectis* is readily distinguishable in the male sex by the blackish irroration on the hindwings and abdomen, this being absent in the male of *tricentra* ; but the females are practically indistinguishable. It will be useful if we can get a good series of specimens from all localities in which *Laspeyresia* damages Sann-hemp, so that we can see which species is really implicated. At Pusa *L. pseudonectis* is the common species and so far we do not seem to have found *tricentra* here, whereas *tricentra* is apparently common in Western India. As Mr. Ghosh was rearing *pseudonectis* here last year, perhaps he will tell us something about it.

Mr. Ghosh. *Laspeyresia pseudonectis* attacks Sann-hemp whilst the crop is still young, about five or six inches high. At that stage of growth the caterpillar attacks the topshoot which is formed into a characteristic gall. The attack does not stop altogether the growth of the plant, which grows in length. In later stages of growth of the plant, the attack takes place at the axils of leaves, where also a swelling is formed. In this latter case, the fibre is affected. There may be more than one gall

in the same plant. The caterpillar feeds inside the gall and pupates there; whilst young it is green but becomes a bright red colour just before pupation. The caterpillar has been found to affect the capsules also, boring the seeds, but this is unusual and this habit has only been observed hitherto during the winter months. The insect hibernates as a caterpillar from November to February and then æstivates from March to June; it may be in the stem if the plants remain in the field or, if the pods are collected, the caterpillars form cocoons amongst the debris and remain there.

As regards control in the case of young plants the removal and destruction of the galled topshoots is necessary and this should reduce further damage.

Laspeyresia occurs in the Central Provinces as a minor pest of Sann-hemp.

At Surat Sann-hemp was grown for green-manure and was seriously attacked by a *Laspeyresia* [probably *L. tricentra*, T. B. F.]. The affected topshoots were removed.

Sphenoptera arachidis occasionally occurs in Sann-hemp but is scarcely a pest as far as we know. The identification requires confirmation. We have a specimen in the Pusa collection under the name *S. gossypii*, which was reared from Sann-hemp, but it is more probably *S. arachidis*.

? *Nupserha* sp. Last year we found a Longicorn beetle, apparently a species of *Nupserha* or closely allied thereto, boring in the stems of Sann-hemp.

This beetle was noticed for the first time at Pusa in 1916. The beetle rings the stems in two places about an inch apart and thrusts its egg into the centre of the ringed portion, which is usually at some distance below the top of the plant, but may be towards its base. The stem above the ringed portion dries up and the grub bores both upwards into the dry portion and downwards in the living stem. Pupation takes place in the stem. The adult beetle is very active and takes wing readily. The insect was very common last year about August, the total damage all over the Pusa Estate aggregating about two to three per cent.

As regards control, the dry plants are easily noticeable and may be removed and destroyed before the beetles emerge. The length of life-history is about four to five weeks.

We have prepared figures showing the damaged plants and the lifehistory of the beetle. It is rather an interesting example of the way in which an insect may suddenly appear as a pest.

A similar insect was noticed at Samalkota ten years ago, but it never reappeared.

Attacking the pods and seeds of Sann-hemp we get a good many pests but we have already dealt with most of the worst ones. They are :— **Mr. Fletcher.**

Utetheisa pulchella.
Etiella zinckenella.
Polyommatus bœticus.
Argina cribraria.
Heliothis obsoleta.
Celama squalida.

Utetheisa pulchella and *Argina cribraria* we have already dealt with under Sann-hemp.

Etiella zinckenella attacks Sann-hemp seeds as it does other Leguminosæ. In some districts it is a bad pest, second only to *Utetheisa*. We have come across it several times already to-day and I have nothing more to add here.

Polyommatus bœticus occurs occasionally in the pods but has not yet been noticed as a real pest of Sann-hemp. However, it is quite likely to take to this foodplant if the cultivation is extended.

Heliothis obsoleta is occasionally found in Sann-hemp pods but not as a pest.

Celama squalida (Arctiadæ) has been reared at Pusa from caterpillars found on Sann-hemp pods but has only been found in small numbers so far.

Then we have a few sucking insects on Sann-hemp :—

Ragmus importunitas.
Nezara viridula.

Ragmus importunitas is described and figured in "South Indian Insects" [p. 491, fig. 378]. It is a small greenish Capsid bug, easily distinguished by the series of round black spots on the hind-leg. It seems to be common in Madras, especially on young plants, and may do a good deal of damage, the leaves curling up and becoming pale-yellow. As it is chiefly bad on young plants it may be controlled by bagnets or handnets.

We get it in Nagpur, chiefly on young plants. **Mr. Khare.**

I have not noticed it at Pusa. **Mr. Ghosh.**

Nezara viridula is described and figured in "South Indian Insects" [p. 473, fig. 352], and we have since issued a coloured plate of this species. It is, however, very variable in colour and markings. It is occasionally found in small numbers on Sann-hemp but is scarcely a pest as a rule. **Mr. Fletcher.**

In Burma *Nezara viridula* occurs on Sann-hemp, but is not a pest. **Mr. Shroff.**

DHAINCHA (*Sesbania aculeata*).

On the leaves of *dhaincha* we find :—

Catopsilia pyranthe.
Terias hecabe.
Terias silhetana.
Zizera otis.
Epacromia tamulus.
Myllocerus 11-pustulatus.

Catopsilia pyranthe ["South Indian Insects," p. 413, fig. 286] and probably other species of *Catopsilia* sometimes occur on *dhaincha* leaves in some numbers but rarely as pests.

Terias hecabe and *T. silhetana* both occur commonly and sometimes do considerable damage. These two species of *Terias* are very close to one another, but the caterpillars may be distinguished fairly easily, as in *hecabe* the caterpillar has a green head and is solitary, whereas in *silhetana* the caterpillars have black heads and are gregarious. In *silhetana* also the blackish pupæ are gregarious and one may find forty or fifty all attached to one twig or stem. *T. hecabe* is figured in "South Indian Insects" [p. 414, fig. 287] and we have since issued a coloured plate showing its lifehistory. As regards control, the caterpillars may be checked by spraying with a stomach poison and in the case of *silhetana* they may be collected by hand.

Zizera otis has occurred at Pusa in some numbers on *dhaincha* grown in experimental plots but does not seem to be a pest on a large scale.

In an experimental plot of *dhaincha* grown by the Imperial Agricultural Bacteriologist, when the plants were 1½ to 2 feet high, the top leaves were attacked by *Terias* and also by many caterpillars of *Zizera otis*. They were hand-picked.

Epacromia tamulus ["South Indian Insects", p. 525, fig. 417] has been found in South India on *dhaincha*. I do not think there is anything to add to the account already given.

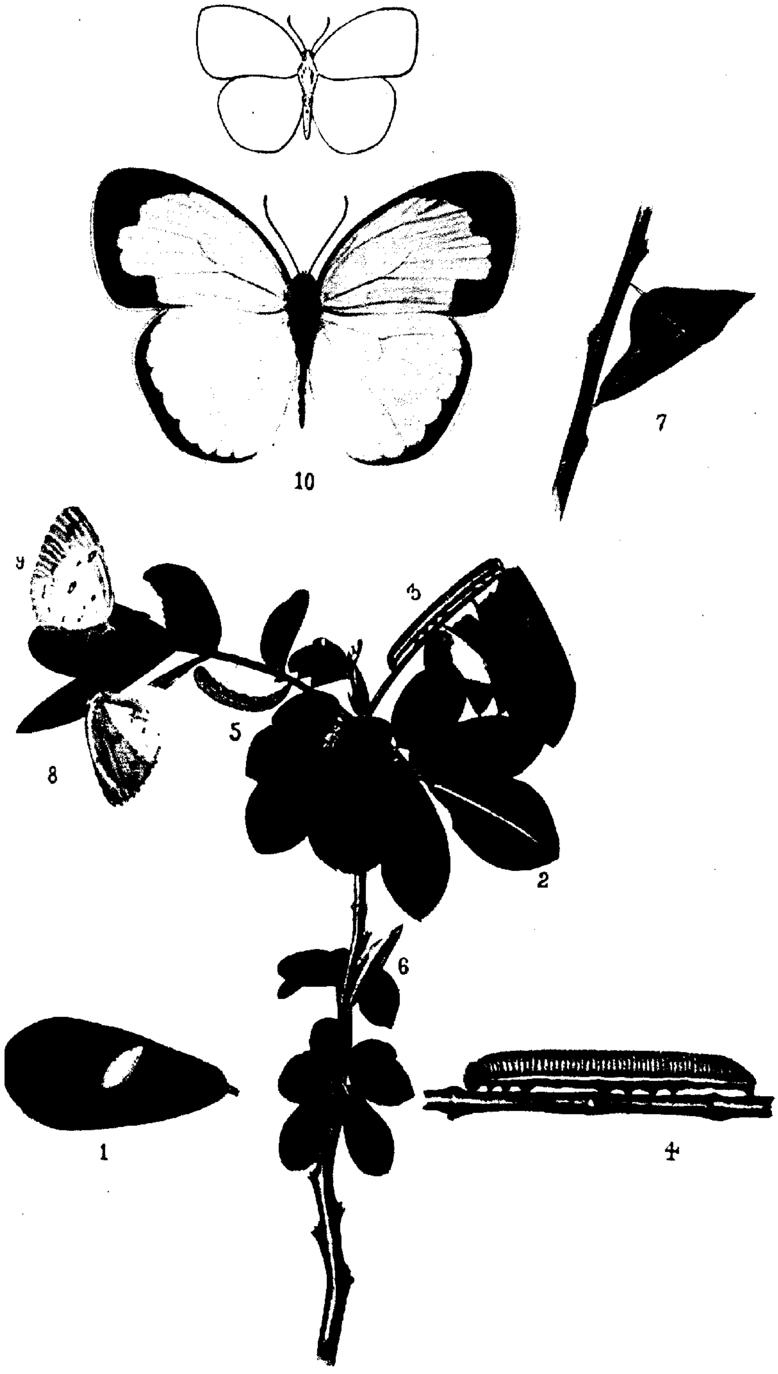
Myllocerus 11-pustulatus occurs on the leaves in most districts but is of little importance as a pest.

Cantharis hirticornis was noticed in Bengal feeding on *dhaincha* leaves, when the plants were five to six feet high.

A black species of Thrips was bad at Pusa in July 1916 on an experimental plot of *dhaincha* grown by the Imperial Agricultural Bacteriologist —the same plot as that referred to before as attacked by *Zizera otis*. The attack was checked successfully by spraying with resin compound, of which one application was sufficient.

Terias hecabe, L.

Fig. 1, egg (enlarged).
Figs. 2 to 4, caterpillar, natural size and enlarged.
Fig. 5, pupating caterpillar.
Figs. 6 and 7, pupa (natural size and enlarged).
Figs. 8 to 10, (butterfly natural size and enlarged), in sitting and flying attitudes.



TERIAS HECABE

Mr. Fletcher Boring in the stem of *dhaincha* we get :—

Alcides bubo.
Azygophleps scalaris.

Alcides bubo seems to occur chiefly in Madras. It is described and figured in "South Indian Insects" [pp. 337-338, fig. 196]. Have you anything more to add to this account, Mr. Ramakrishna Ayyar ?

Mr. Ramakrishna Ayyar. *Alcides bubo* is not so bad on *dhaincha* as it is on the other species of *Sesbania*.

Mr. Fletcher. Then we will discuss it under *Agathi*.

Azygophleps scalaris is another insect which is more common in Madras but it also occurs as a pest as far north as Orissa and in Burma. Last year I got a specimen of the moth attracted to light here at Pusa, so that it does occur here although the larva has never been noted. It is probable that it has not attracted much notice in other parts of India because *dhaincha* has not been grown much outside of Madras, Burma and Orissa, but if its cultivation is extended for use as a green manure, we shall probably hear of *Azygophleps* as occurring in other districts. This species is described and figured in "South Indian Insects" [pp. 446-447, fig. 321] and I have nothing new to add to the account given there.

Mr. Ramachandra Rao. The lifehistory has been described there and there is no more to add.

Mr. Ghosh. Last year on the Pusa Farm some *dhaincha* was grown, but the young plants were eaten back by *nilghai*.

Mr. Fletcher. A few sucking insects are found on *dhaincha*. *Coptosoma* sp. sometimes occurs but is hardly a pest. In fact, *dhaincha* seems rather free, so far as we know at present, of pests of this sort.

Then there are a few insects found in the pods :—

Pachytychius mungonis.
Megastigmus sp.

Pachytychius mungonis was discussed under *mung* and *urid* and I do not think there is much to add.

Mr. Ramakrishna Ayyar. It occurs in the pods at Coimbatore.

Mr. Fletcher. *Megastigmus* has been found at Coimbatore, the larva boring in the seeds. It is an interesting example of a plant-feeding group in the Chalcididæ which, as you know, are practically all parasitic on other insects. We shall come across another case of the same kind later on when we come to deal with pests of Apricot. Will you tell us about this *Megastigmus*, Mr. Ramachandra Rao ?

Mr. Ramachandra Rao. At Coimbatore *dhaincha*, grown for seed, was attacked by this insect so badly that only a few seeds could be obtained. From fifty to seventy-five per cent. of the seeds were destroyed. There is no doubt about

As this insect is a stem-borer, how is it checked by spraying with Lead Arsenate ?

The weevils feed on the young leaves.

Amongst sucking insects, *Coptosoma cribraria* occurs, but is not much of a pest.

Then in the pods a *Megastigmus* has been reared at Coimbatore from larvæ boring in the seeds. It is apparently the same as the one we have just discussed under *dhaincha*.

CHITAGATHI (*Sesbania aegyptiaca*).

Chitagathi has much the same pests as *agathi*, so I need only mention them.

On the leaves we get :—

Homoptera glaucinans.
Catopsilia pyranthe.
Terias hecabe

and boring in the stem we find :—

Azygophleps scalaris.

ERYTHRINA (*Erythrina indica* and *E. lithosperma*).
[*Dadap* ; Coral Tree.]

Both of these species of Erythrina are grown to a considerable extent, *E. indica* being used frequently as an ornamental tree in gardens and *E. lithosperma* being grown very extensively in the Hills as shade and green-manure for tea and coffee. A species of *Erythrina* is also used in Bombay as a support for grape-vines, so that the pests of this tree may be of considerable economic importance in some districts.

The young plants are attacked by the large Coreid bug, *Anoplocnemis phasiana* ["South Indian Insects," pp. 477-478, fig. 360]. This bug is found on large trees also but is a specific pest of young trees by sucking the tender shoots, thus checking growth. It is a curious fact, which I noticed in Ceylon many years ago now, that when this bug occurs in this way on young trees, it usually occurs in pairs, a male and a female together. The bugs are fairly easily collected and destroyed.

On the leaves of *Erythrina* we find a large number of miscellaneous insects but there are few serious leaf-eating pests :—

Platypria hystrix.
Platypria echidna.
Episomus lacerta.
Acherontia lachesis.
Orgyia postica.
Aularches miliaris.

Platypria hystrix [" South Indian Insects," p. 316, fig. 167] and the very similar *P. echidna* both occur commonly on the leaves and do a little damage at times. I have seen the leaves riddled with holes produced by these species but one generally only finds this in odd patches here and there and *Platypria* are not serious pests.

Episomus lacerta [" South Indian Insects," pp. 327-328, fig. 181] occurs in small numbers on the leaves. I have found it in Coorg on *Erythrina* leaves at Pollibetta and Mercara, but it is quite a minor pest.

Acherontia lachesis occurs commonly on *Erythrina* and by its large size the caterpillar [" South Indian Insects," p. 131, fig. 59] may do considerable damage, one caterpillar being quite capable of defoliating a small branch. The caterpillars may be handpicked, although they are not always very easy to see.

Orgyia postica [" South Indian Insects " pp. 395-396, fig. 263] occurs fairly common as a caterpillar on *Erythrina* leaves but is scarcely a pest.

Aularches miliaris [" South Indian Insects, p. 526, fig. 418] is sometimes common on *Erythrina* and is a sporadic minor pest.

Boring in the shoots of *Erythrina* we find :—

Terastia meticulosalis
A Trypaneid fly.

Terastia meticulosalis [" South Indian Insects ", p. 438, fig. 315] is sometimes a serious pest, especially of *Erythrina indica*, the larva boring in the young shoots so that all the new growth may be killed back. The attacked shoots are fairly evident and may be cut back and the caterpillar destroyed.

In Coorg I have found a Trypaneid fly breeding in the shoots, but it is not a pest and at present we know very little about it.

Under the heading of " Boring Insects " we may include *Sthenias grisator* [" South Indian Insects", p. 326, fig. 182], which is quite a serious pest of *Erythrina* when grown as a shade-tree amongst coffee. The adult beetles have the curious habit of girdling branches, and even main stems in the case of young trees. A groove about a quarter of an inch wide is eaten right through the bark all around the branch which may be as much as three inches in diameter, and the portion above the girdling dies back in consequence. The eggs are thrust into this girdled branch and according to my observations they are generally, or at least very frequently, placed just under the bark where it is cut by the girdling. The larvæ feed in the girdled branch, which remains on the tree for some time but drops off sooner or later, and pupation takes

Laphygma exigua is a sporadic major pest of seedlings of both varieties of indigo, occurring in Bihar usually about April. In 1906 it was very bad at Birowli, near Pusa, on *sumatrana* plants. In the case of very bad outbreaks, the only practical remedy seems to be to cut the plants back. Spraying may also be tried, and trenches should be dug between badly attacked areas and adjacent ones free from attack to prevent the caterpillars crossing over, but this of course will not prevent the moths from doing so.

Agrotis ypsilon is not serious on indigo but attacks *sumatrana* seedlings to some extent, doing less damage to *arrecta* seedlings.

There is a long list of leaf-eating insects found on indigo, but none are very important as regards the well-grown plants :—

Prodenia litura.
Chilades putli.
Dichomeris ianthes.
Heliothis obsoleta.
Pelamia (Remigia) undata.
Chalciope (Trigonodes) hyppasia.
Raparna nebulosa.
Plusia limbirena.
Plusia orichalcea.
Monolepta signata.
Blosyrus inæqualis.
Sitones crinitus.
Tanymecus circumdatus.
Tanymecus indicus.
Myllocerus viridis.

Prodenia litura is a minor pest of indigo.

Chilades putli is sometimes found on indigo shoots but does little damage.

Dichomeris ianthes we have already discussed under clusterbean. It is a minor pest of indigo, the larvæ webbing up the leaves and top-shoots. The attacked portions may be removed and destroyed, but as a rule no control is required.

Heliothis obsoleta is of comparatively rare occurrence on indigo and is scarcely a pest.

Pelamia undata [" South Indian Insects," p. 388, fig. 252] and *Chalciope hyppasia* [" Indian Insect Life," p. 451, fig. 311] are both occasional pests of indigo but are usually of no importance.

Raparna nebulosa, *Plusia limbirena*, and *P. orichalcea* have all been found on indigo, but not recently, and do not seem to be regular pests.

Dichomeris iunthes, Meyr. (*Ypsolophus ochrophanes*, Meyr.)

Fig. 1, an affected Java-Natal indigo plant.
Fig. 2, egg enlarged.
Fig. 3, caterpillar.
Fig. 4, pupa.
Figs. 5 and 6, moths in flying and resting attitudes.
The hair-lines indicate natural sizes.

DICHOMERIS IANTHES.
(YPSOLOPHUS OCHROPHANES.)

Monolepta signata has been found on indigo at Pusa. It occurs on numerous plants and is not a pest of indigo.

Blosyrus inæqualis was found on indigo in some numbers at Nellikuppam, but we do not know any more about it as a pest.

Sitones crinitus has been found on indigo at Dalsing Serai and in Champaran, but is not known as a pest.

Tanymecus circumdatus and *T. indicus* both occur on indigo at Pusa but in quite small numbers.

Myllocerus viridanus we have from Nellikuppam on indigo but we do not know it as a pest.

Indigo seems to be rather free from stem-borers. We have a record of *Alcides bubo* as found on indigo at Palur, in South Arcot, but whether it was breeding in indigo we do not know. *Anataractis plumigera* (Cosmopterygidæ) was reared from a gall in a stem of *Indigofera linifolia* at Pusa [see Entomological Note No. 83], but we have not noticed it in any cultivated indigo.

The sucking insects found on indigo, however, are of more importance, and in this group we get

Psylla isitis (*Psyllopa punctipennis*).
Aphis cardui (?).
Dolycoris indicus.
Anoplocnemis phasiana.
Thrips.
Mites.

Psylla isitis has acquired a literature of its own and you will find accounts in our Entomological Memoirs, Vol. IV, No. 6 and in the "Agricultural Journal of India" for January 1913. I do not think there is much to add to these so far as we are concerned.

Mr. Ghosh. I can only add one remark. If by varying the method of cultivation it be possible to have only grown-up "moorhun" plants in July-August, there will be hardly any *Psylla*, as this is the time of year most favourable in Bihar for the growth and multiplication of *Psylla*.

Mr. M. M. Lal. *Psylla* occurs on indigo in the Punjab at Multan, Muzaffarnagar and Dhera Ghazi Khan, but never gives much trouble.

Mr. Ramakrishna Ayyar. In Madras indigo is attacked by *Psylla* at Palur and Bellary.

Mr. David. In the United Provinces *Psylla* attacks indigo.

Mr. Fletcher. An Aphid, which is probably *Aphis cardui*, occurs commonly on indigo and is a sporadic pest of young plants. We constantly get reports from the Indigo Planters round about Pusa and have sent out men and apparatus to control it several times. It is fairly easily controlled

by use of a Soap solution. Under natural conditions it is usually checked by Coccinellid beetles.

In the indigo-growing districts of the Punjab an Aphid is found on the plant buts does not do much damage.

Dolycoris indicus occurs on indigo as on numerous other plants but is not a regular pest.

Anoplocnemis phasiana has been reported on indigo at Cawnpur but we have never seen it on indigo in Bihar.

It was found on indigo at Cawnpur in small numbers in July 1915 but did not do much damage.

Thrips, whether of one or more species we do not know, are found on indigo but not as a serious pest.

Thrips occurs on indigo in the Bellary District.

Thrips is found commonly at Pusa but is never serious.

Mites also occur on indigo, but we know very little about them and they do not seem to be real pests.

Mites also are found occasionally at Pusa but are not serious. They cover the leaves with a thin webbing and puncture them. They have not occurred in sufficient numbers to require control.

The roots of indigo plants are sometimes cut by crickets of sorts and *Schizodactylus monstrosus* is commonly accused of doing this in Bihar, where it is known as "bherwa." There is no doubt that *Schizodactylus* may do damage at times, but this seems to be accidental and only incidental to its activities when tunnelling underground. We have reared this insect at Pusa and found that it is exclusively carnivorous, feeding on small frogs, caterpillars, and so on, and starving rather than feeding on roots and vegetable diet. The species is widely distributed in India. It is common in Bihar and extends as far south as Bellary and is also found in North-Western India. It is described and figured in "South Indian Insects" [p. 533, fig. 427] and we have since issued a coloured plate showing all stages of its lifehistory.

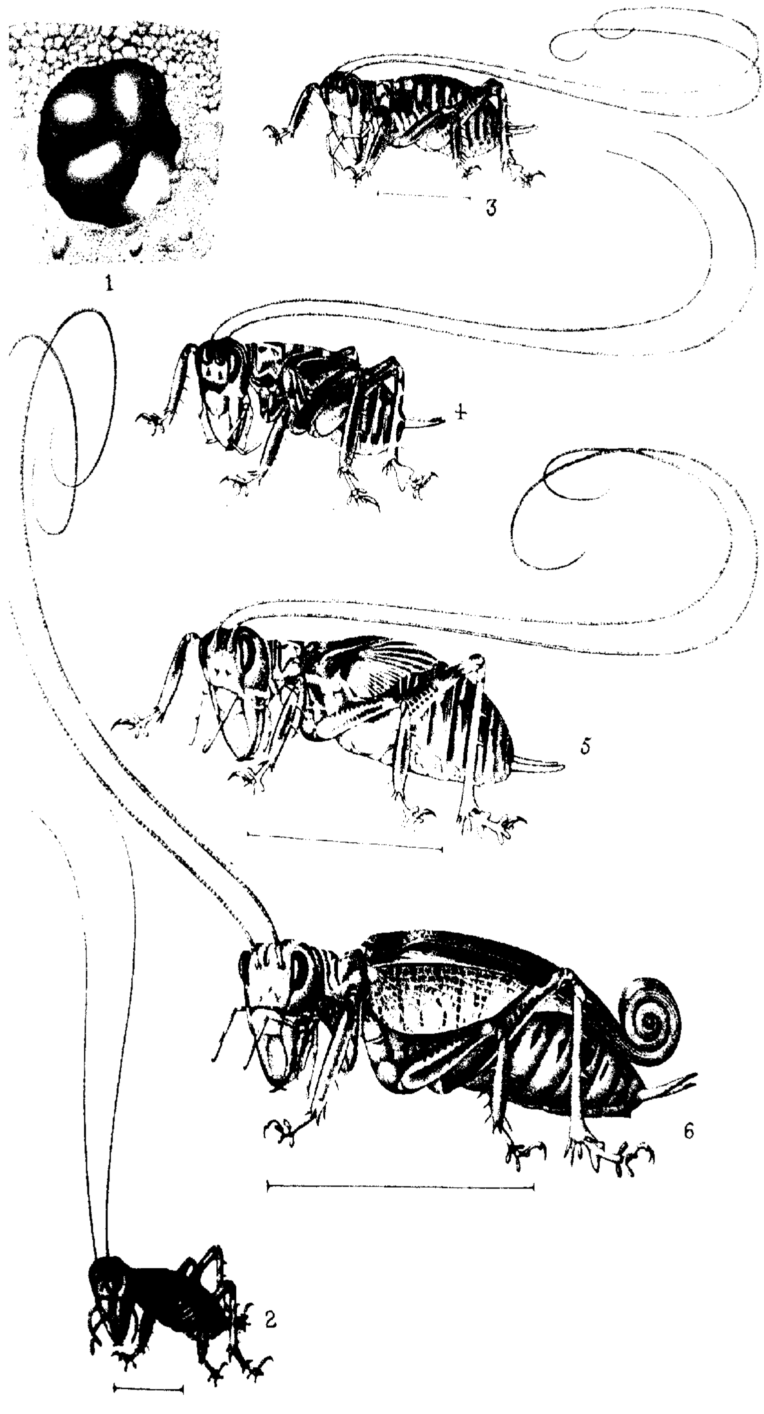
In many cases where *Schizodactylus* is accused of damage, there is no doubt that it has been confused with *Brachytrypes*, which is the real culprit.

The next group of crops may be taken under the general name of:

OIL-SEEDS

and under this item we will deal with the insect pests of *Sesamum*, castor, linseed, groundnut, niger-seed, sunflower and safflower.

I may remark that it is very difficult to group crops into classes with any exactitude, as in some cases a crop may fall into more than one group, whilst in others it is more convenient to take allied crops



SCHIZODACTYLUS MONSTROSUS.

together as their pests may be very similar. Mustard, for example, might be expected to be included under oil-seeds, but it will be more convenient for our purposes to take it under Cruciferae together with cabbage and other allied crops.

SESAMUM (*Sesamum indicum*).

[*Til*—North India. *Gingelly*—South India.]

Sesamum seedlings are sometimes damaged by *Brachytrypes portentosus*, which we have just discussed under the heading of indigo.

In Bengal, plants about a foot high are damaged in July and August at Dacca by *Brachytrypes*. **Mr. Sen.**

A good many pests occur on the leaves of *Sesamum*, the worst being *Antigastra* :— **Mr. Fletcher.**

Pachnephorus impressus.
Tanymecus chloroleucus.
Anomala antiqua.
Diacrisia obliqua.
Amsacta moorei.
Acherontia styx.
Pericallia ricini.
Laphygma exigua.
Antigastra catalaunalis.

Pachnephorus impressus sometimes occurs in some numbers. The lifehistory is briefly described and figured in Entomological Note 33.

At Hoshangabad *Pachnephorus* is a serious pest of this crop, the beetles feeding on the leaves of the plants. **Mr. Ratiram**

Do you practise any control-methods there ? **Mr. Fletcher.**

The beetles can easily be collected by shaking the plants. They have the habit of taking shelter amongst fallen leaves, so dry leaves are collected and heaped in places and afterwards burnt. **Mr. Ratiram.**

Tanymecus chloroleucus, Wied., a large grey-white weevil with a green tinge, has been found on *Sesamum* at Pusa but is not known to be a pest. **Mr. Fletcher.**

Anomala antiqua was found on *Sesamum* at Tatkon in Burma, but I think it is scarcely a pest.

Diacrisia obliqua occurs on *Sesamum* in all districts where this insect occurs and may do so in destructive numbers. It is especially bad in Bihar and Bengal. Hand-picking of the eggmasses and clusters of young caterpillars is the only effective remedy.

Amsacta moorei seems to replace *Diacrisia* in Bombay. We have already discussed control of this pest.

Amsacta moorei occurs on young plants in Nadiad. **Mr. Jhaveri.**

Acherontia styx [" South Indian Insects," p. 402, tab. 24] is a minor pest of *Sesamum* throughout India and Burma. We have it recorded on this crop from Gujarat, Poona, Nagpur, and Pusa and in Burma I found it at Minbu.

In Burma it has occurred on *Sesamum* at Tatkon also.

The larvæ are large and may usually be hand-picked when they are sufficiently plentiful to require control.

Pericallia ricini [" South Indian Insects," pp. 370-371, fig. 232] has been noted in Madras on *Sesamum* but is not usually a pest of this crop.

Laphygma exigua also occasionally occurs on *Sesamum* but is not a pest so far as we know.

Antigastra catalaunalis [" South Indian Insects," p. 441, tab. 37] occurs throughout India, Burma and Ceylon as a regular minor and occasional major pest of *Sesamum*, the larva rolling and webbing the leaves and boring in the shoots and pods. Beyond the removal of the affected parts of the plants, little control is practicable. An Ichneumon-fly, *Tarytia flavo-orbitalis*, Cam. [see Fauna of India, Hymenoptera, Vol. III, p. 506, fig. 148] has been reared commonly at Pusa as a parasite of *Antigastra catalaunalis*, but this fly appears to be already widely distributed in India and Burma, so that it is apparently not a very effective check.

Antigastra catalaunalis is the most harmful of all the pests of *til* in Bihar. The caterpillars affect the topshoot and the top leaves, rolling them into a sort of a knot and checking the growth of the plants. Sometimes these caterpillars bore into the green pods and eat the seeds inside.

When I was in Minbu, in Lower Burma, in 1914 I found a considerable proportion of seed-pods eaten into. I could not find any insect actually doing it, but I put it down at the time to *Acherontia* which was present in some numbers.

The young capsules of *Sesamum* are damaged by :—

Asphondylia sesami.

Nysius inconspicuus.

Asphondylia sesami is the species described and figured in " South Indian Insects " [p. 364, figs. 224, 225] as the Gingelly Gall-fly. As you will see from the second figure, the growth of the young capsules is stunted so that they become wrinkled, withered galls and considerable loss of crop may result if the attack is bad. This insect is common all over Madras and is sometimes bad on the Farm plots at Coimbatore. We have no records of its occurrence outside of Southern India.

In North Gujarat, this gall-fly occurs at Nadiad in the immature pods of *til* and at times does very serious damage.

Have you tried any control-measures ? **Mr. Fletcher.**

At the Surat Farm, removal of the affected top-shoots is tried. **Mr. Jhaveri.**

That seems the only thing to do but I doubt whether it is practicable on a field scale. **Mr. Fletcher.**

Nysius inconspicuus is a small Lygaeid bug which has been recorded on *Sesamum* in South Kanara. We do not know much about it as a pest.

A few sucking insects are found on *Sesamum* but the only ones that we need mention are :—

Eusarcocoris ventralis.
Aphanus sordidus.

Eusarcocoris ventralis ["South Indian Insects," pp. 471-472, fig. 349] was once found in Ganjam on *Sesamum* as a serious pest, but otherwise we do not know it as doing any damage.

Aphanus sordidus ["South Indian Insects," p. 483, fig. 368] is sometimes a serious pest of *Sesamum* and the bug has the curious habit of sucking the ripe seeds and even of carrying them away. In the case of harvested plants the bugs may be brought in, or may congregate, in very large numbers and may then be killed by beating with brooms or similar weapons.

At Nadiad and in Khandesh *Aphanus* is found in large numbers on harvested plants. **Mr. Jhaveri.**

Thousands of these bugs may occur in the harvesting yard and, when the bundles of plants are shaken or moved, they spread all around. At that time they may easily be swept up and destroyed. **Mr. Ghosh.**

At least one boring insect attacks *Sesamum* and that is *Oberea sesami* (*Lamiadæ*). The egg is laid on the midrib of a leaf, the larva boring into the midrib of the leaf and then downwards into the stem of the plant until it reaches the root, where it pupates. Hibernation takes place in the larval stage. Very serious damage may be done sporadically. As regards control, eight or ten days elapse before the larva bores into the stem and the affected leaves, which show characteristic yellow blotches, may be collected at that time. This insect only seems to have been noticed in Baroda. **Mr. Fletcher.**

In the roots of *Sesamum* there is also a fly, as yet unidentified, but perhaps a species of *Psila*. It is said to be serious at Hoshangabad and has also been noticed at Nagpur and Pusa, but we seem to know very little about it. The larva lives in the roots of the plants and may be a minor pest. The adult is figured in "Indian Insect Life," p. 629, fig. 415.

CASTOR (*Ricinus communis*).

The seedlings of castor are attacked by *Chrotogonus* and the attack may be serious at times. Bagging is a practicable remedy.

On the leaves of castor we find a large number of insects, some of which may be serious pests. As you know, we grow a good deal of castor at Pusa as food for Eri Silkworms, and we are constantly having difficulty with leaf-eating caterpillars which defoliate the plants. Of course, when the leaves are required as food for silkworms like this, it is impossible to use a stomach-poison, but we usually find that hand-picking is effective if taken in hand at once, immediately the attack starts. The pests on my list are :—

Achœa janata.
Prodenia litura.
Diacrisia obliqua.
Pericallia ricini.
Amsacta moorei.
Trabala vishnu.
Ergolis merione.
Altha nivea.
Parasa lepida.
Orgyia postica.
Olene mendosa.
Euproctis fraterna.
Euproctis scintillans.
Clania crameri.
Myllocerus viridanus.
Cyrtacanthacris ranacea.

Achœa janata (*Ophiusa melicerta*) ["South Indian Insects," pp. 386-387, fig. 250] is the most common and destructive pest of castor, the caterpillars absolutely stripping the leaves when present in large numbers. This is one of the commonest insects that we find on our castor-plants here and prompt hand-picking of the young caterpillars is generally effective.

Prodenia litura ["South Indian Insects," p. 377, tab. 19] is also common on castor all over India and sporadically destructive. Collection of eggmasses and young larvæ forms an effective check.

Diacrisia obliqua is also common and sometimes destructive, in Bengal and Bihar. Control as in *Prodenia*.

Pericallia ricini ["South Indian Insects," p. 370, fig. 232], as its name implies, occurs on castor but is not often a bad pest. Hand-picking of larvæ is effective.

Amsacta moorei occurs chiefly in Bombay.

In North Gujarat it is a bad pest on young plants. **Mr. Jhaveri.**

Trabula vishnu occurs sporadically at Pusa, generally in the Rains, and is sometimes quite a pest. Handpicking again is found effective. **Mr. Fletcher.**

Trabala vishnu occurs casually on castor in Burma. **Mr. Shroff.**

It does not seem to be a pest except in Bihar and there only now and again. **Mr. Fletcher.**

Ergolis merione occurs commonly on castor but is scarcely a pest. Isolated plants are often stripped of leaves but, when grown as a field crop, castor seems fairly immune from this caterpillar. It is notable that in Madras the caterpillars of the South Indian form of this butterfly do not seem to do any damage to castor and perhaps have another food plant.

Altha nivea [" South Indian Insects," pp. 411-412, fig. 285] seems to occur occasionally on castor in most parts of India, but is not known to be a regular pest.

Parasa lepida [" South Indian Insects," pp. 410-411, ff. 283-284] occurs sporadically on castor in most localities, especially in Madras, and may do considerable damage. The caterpillars may be collected but should not be touched with the bare hands as their spines are highly poisonous. They are gregarious when young and so may be collected fairly easily if the attack is taken in time.

Parasa lepida sometimes occurs in large numbers on castor in Madras. **Mr. Ramakrishna Ayyar.**

Gryyia postica is another sporadic pest of castor. As a pest of castor it has been noticed chiefly in Southern India. **Mr. Fletcher.**

There was a bad outbreak at Coimbatore in December 1916-January 1917. **Mr. Ramakrishna Ayyar.**

It occurs in Mysore also on castor. **Mr. Kunhi Kannan.**

Olene (*Dasychira*) *mendosa* [" South Indian Insects," p. 396, fig. 264] is also rather a sporadic pest of castor but is usually only a minor pest. **Mr. Fletcher.**

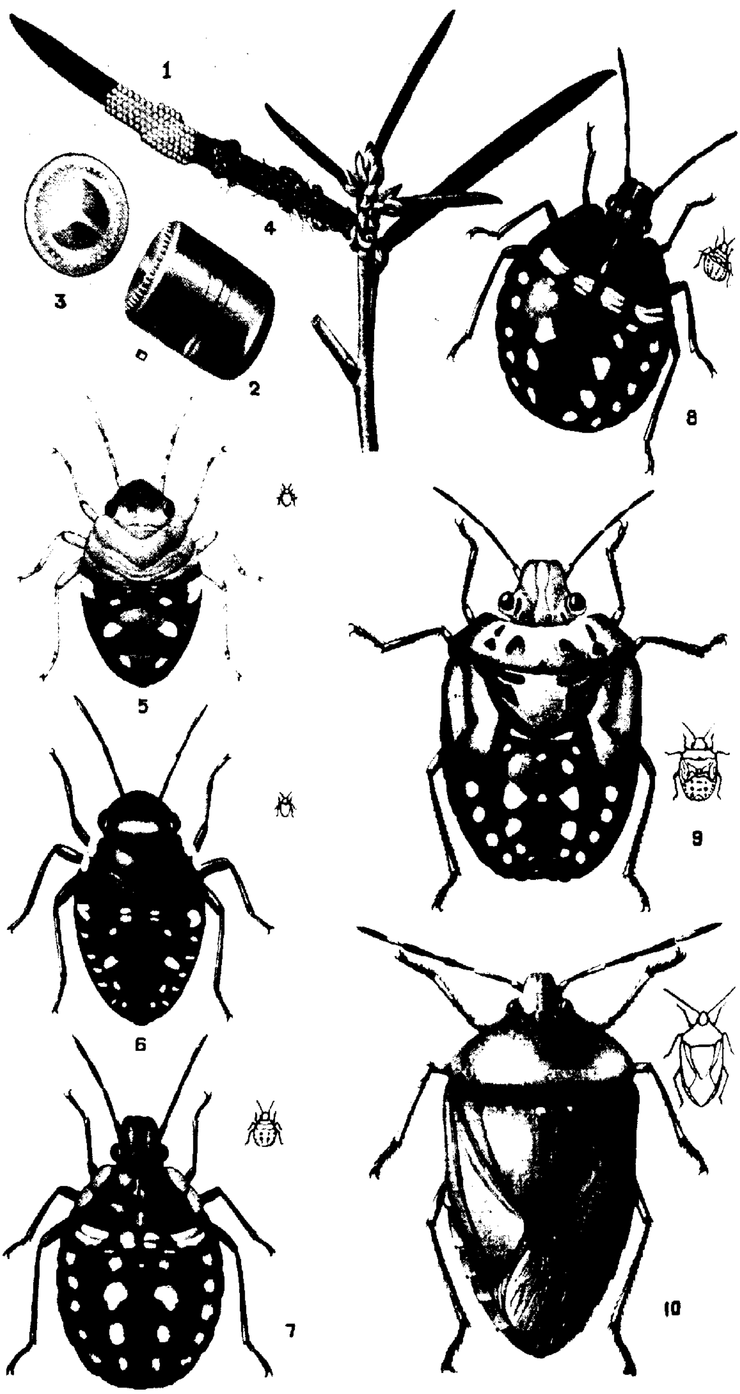
Euproctis fraterna [" South Indian Insects," p. 398, figs. 266-267] and *E. scintillans* [*l.c.*, p. 399, fig. 268] are both rather minor pests of castor as a rule, but *fraterna* is sometimes rather a serious pest in Southern India. I have discussed both these species in my book and have no more to add now.

E. fraterna occurs in Southern India chiefly on isolated plants. **Mr. Ramakrishna Ayyar.**

Clania crameri [" South Indian Insects," p. 448, fig. 325] also occurs chiefly on isolated plants. It is scarcely a pest on castor and the larval cases are fairly easily seen and collected. **Mr. Fletcher.**

Schizodactylus monstrosus, Dr.

Fig. 1, eggs in their natural burrow.
Figs. 2 to 5, nymphs in different stages of growth.
Fig. 6, adult.
The lines alongside the figures indicate their natural sizes.



Nezara viridula.

Nezara viridula, Linn.

Fig. 1, An egg cluster on a *mung* pod;
Fig. 2, A single egg (magnified);
Fig. 3, Top of the egg (magnified);
Fig. 4, Young nymphs;
Figs. 5-9, Nymphs in various stages of development (magnified);
Fig. 10, Adult (magnified).
Outline figures show the natural sizes.

Nezara viridula is common on castor as on so many other plants and is often a minor pest. The bugs may be collected by hand or in hand-nets. **Mr. Fletcher.**

Mites are found throughout our limits on castor and are sometimes serious pests. Spraying with Crude Oil Emulsion mixed with Flowers of Sulphur will usually check them successfully.

LINSEED (*Linum usitatissimum*).

Linseed does not seem to have any very serious regular pests but is attacked by a good many insects, all of which seem to be caterpillars. On the leaves we get :— **Mr. Fletcher.**

Diacrisia obliqua.
Plusia orichalcea.
Prodenia litura.
Laphygma exigua.
Grammodes stolida.
Euproctis scintillans.

Most of these are polyphagous species which we have already dealt with under other crops, so we need not consider them again in any great detail.

Diacrisia obliqua occurs occasionally in some numbers on linseed in Bihar and Bengal, and hand-picking of eggmasses and young larvæ is effective as a check.

Plusia orichalcea has been found on linseed at Pusa.

At Cawnpur Farm *Plusia orichalcea* occurred on linseed the year before last. **Mr. David.**

Prodenia litura has been noted on linseed at Kot Chandpur, in the Jessore District, but is not a regular pest of this crop. **Mr. Fletcher.**

Laphygma exigua has been recorded on linseed in the Central Provinces.

Linseed was attacked by *Laphygma exigua* at Nagpur. **Mr. Khare.**

At Mandalay Farm also linseed was attacked by *Laphygma exigua.* **Mr. Shroff.**

Laphygma occurs throughout India and Burma and may occur, anywhere that linseed is grown, as a pest of this crop. **Mr. Fletcher.**

Grammodes stolida [" South Indian Insects," pp. 387-388, fig. 251] is the nearest approach that we seem to have to a specific pest of linseed. It is an occasional minor pest in Madras but does not seem to have been noticed elsewhere although this insect is widely distributed throughout India and Burma.

Euproctis scintillans [" South Indian Insects," p. 399, fig. 268] occurs throughout India, Burma and Ceylon and is a sporadic minor pest of linseed, on which crop it has been noted at Pusa, Nagpur and in Madras. The larvæ may be hand-picked but should not be handled as the hairs produce irritation.

In Bengal a caterpillar was reported from Faridpur as cutting linseed plants, and the insect concerned was identified by me as *Agrotis ypsilon*.

Linseed capsules are sometimes attacked by larvæ of *Heliothis obsoleta*, but it does not seem to be a regular pest of this crop.

Heliothis obsoleta sometimes occurs on linseed in the Punjab but the damage done is negligible.

Groundnut (*Arachis hypogæa*).

It would have been more natural to have taken groundnut under " Leguminous Field-crops," but it is perhaps more convenient to consider it with other " Oilseeds." Groundnut has a long list of pests, many of which do a great deal of damage. On the flowers we get :—

Oxycetonia versicolor.
Meloid beetles.
Thrips.

Oxycetonia versicolor [" South Indian Insects," p. 283, fig. 123] occurs on the flowers and shoots at Coimbatore and other localities in South India and does some damage at times but is not a serious pest as a rule. The beetles are easily collected by hand.

Meloid beetles of various kinds do similar damage in most localities but are also collected fairly easily.

Thrips also occur on the flowers and probably do damage but we really know very little about this.

On the leaves we get :—

Chrotogonus spp.
Cyrtacanthacris ranacea.
Orthacris sp.
Diacrisia obliqua.
Amsacta albistriga.
Amsacta moorei.
Creatonotus gangis.
Prodenia litura.
Heliothis obsoleta.
Plusia signata.
Anarsia ephippias.
Aproærema nerteria.

Myllocerus viridanus.
,, *dentifer.*
,, *discolor.*
,, *dorsalis.*
Thrips.
Mites.

The grasshoppers occur as minor pests, especially on young plants, and can be dealt with by bagging when damage is being done.

Diacrisia obliqua occurs as a serious pest of groundnut in localities where this insect occurs, but fortunately it does not occur in the groundnut-growing districts of Southern India. When groundnut was grown experimentally at Pusa it was badly attacked by *Diacrisia*. Hand-picking of eggmasses and young larvæ is the only thing to do.

Mr. Shroff. In Burma *Diacrisia* is a serious pest of groundnut.

Mr. Fletcher. *Amsacta albistriga* and *A. moorei* occur as regular pests of groundnut in Southern India. We have already discussed* these species and there seems to be no need to go over the ground again.

Creatonotus gangis [" South Indian Insects," pp. 369-370, fig. 231] is a sporadic minor pest of groundnut in Madras but does not seem to have been noted on this crop elsewhere although it is common throughout India and Burma and has a wide range of foodplants.

Prodenia litura was found at Pusa on groundnut when this crop was grown here, but it was a minor pest of much less importance than *Diacrisia obliqua*. It may occur in almost all districts as a sporadic pest.

Heliothis obsoleta has been found on groundnut in Madras but apparently not elsewhere, and does not seem of any importance as a pest of this crop.

Plusia signata [" South Indian Insects," p. 393, fig. 259] occurs on tender leaves in Madras but is of very minor importance as a pest.

Anarsia ephippias [" Indian Insect Life," p. 534, tab. 56] occurs probably throughout the Plains of India as a very minor pest of groundnut, on which it has been found at Pusa, the larva rolling the leaves and boring the topshoots which are killed back. Hand-picking of attacked leaves and shoots will provide control, the withered shoots being easily seen.

Mr. M. M. Lal. In the Punjab *Anarsia* attacks groundnut and is a fairly bad pest of this crop. Picking out the rolled-up leaves in early stages of attack is generally done and at the Farm spraying with Lead Chromate is also done at times.

* *See* pages 53-55.

Aproœrema nerteria [" South Indian Insects," pp. 457-458, fig. 333] is widely distributed in most parts of the Plains of India but is apparently not known in Bombay. In Madras it is well known, under the name *Surul-puchi*, as a serious pest of groundnut and it occurs as far north as the North-West Frontier Province, so that its apparent absence in Western India is perhaps due simply to want of observation there. Besides groundnut it occurs on soy bean, *Cajanus indicus* and *Psoralea corylifolia*. Our records include the following localities and foodplants :—

Peradeniya—Groundnut (destructive in February 1905).
Coimbatore—Groundnut.
Hagari—Groundnut (top leaves).
Sundarbans—
Nagpur—Soybean, *Psoralea corylifolia.*
Pusa—Soybean, *Psoralea corylifolia.*
Peshawar—(Moths only).

As regards its lifehistory and control, I have no more to add beyond what is given in " South Indian Insects." This is a species which badly wants working at, to find out more about it before we can tackle it really satisfactorily. We should like to know whether it really occurs in Bombay and also in Burma.

It has not been noticed in Bombay.

Nor in Burma.

That does not prove that it does not occur. It has never been recorded from the Punjab but doubtless occurs there also as I found it common as far north as Peshawar. It is quite likely that lucerne, *shaftal* and *bersim* may turn out to be alternative foodplants.

The weevils on the list are usually of minor importance but sometimes occur in sufficient numbers to damage the leaves. We have records of *Myllocerus viridanus* at Chepauk and in abundance at Palur, of *M. dentifer* and *M. discolor* at Palur, and of *M. dorsalis* at Villapuram. *Myllocerus viridanus* [" Fauna of India," Curculionidæ, Vol. I, pp. 301-303, fig. 93] has also been recorded on groundnut from Trichinopoly and seems to be the species most commonly found on this crop.

Thrips sometimes occur on the leaves, and do some damage, but these are insects that we really know nothing about in India as yet.

At Palur in 1916 Thrips was bad on groundnut.

Mites also sometimes damage groundnut leaves but here again we come to a group that we know nothing about.

Mites are sometimes very bad, the attacked plants turning pale yellow. Dusting with Sulphur has been tried with success on a plot of three to four acres. **Mr. Ramakrishna Ayyar.**

Jassids were reported to have done some damage to groundnut at Kanki Farm, near Ranchi, in September 1915. I visited the Farm at that time and found some green Jassids still on the plants. Mr. Dobbs said that there had previously been a large number of these insects. I found, on examining the plants, that the undersurfaces of the leaves were discoloured as if scorched ; at that time the attack was over and the plants were recovering to a great extent. No control measures had been applied. **Mr. Ghosh**

Boring in the stem of groundnut we have *Sphenoptera arachidis* ["South Indian Insects," pp. 298-299, figs. 141, 142] which has been called *arachidis* because it attacks groundnut especially, although I may note that this name is a *nomen nudum*. In Madras it is known as *ver-puchi* in groundnut-growing districts and in South Arcot especially it is often a serious pest. It is an insect which requires further investigation, pending which we can only advise destruction of attacked plants. **Mr. Fletcher.**

Some years back *Sphenoptera arachidis* was found at Hagari in the Bellary District. In that district it is not a serious pest and only appears sporadically. The people pull out the affected plants and destroy them. **Mr. Ramachandra Rao.**

This insect occurs in Bombay also. In 1914, in an isolated plot of groundnut, some plants were found dying. On cutting up the affected plants, this borer was discovered inside the stems. It has never been reported as a serious pest in Bombay. **Mr. Jhaveri.**

The seeds of groundnut are attacked by *Aphanus sordidus* ["South Indian Insects," p. 483, fig. 368] whose habits we had occasion to notice before under *Sesamum*. Its habits as regards harvested groundnut crops are much the same and this insect is often found in very large numbers on harvesting-floors. **Mr. Fletcher.**

The adult bug occurs on the groundnut plants in the fields and probably sucks the sap of the shoots and leaves. **Mr. Ramachandra Rao.**

Yes ; that is noted in my book. It is, however, on the harvested crop that the bug becomes a pest. I do not think we know anything about its early stages and where they are passed. **Mr. Fletcher.**

The roots of groundnut are attacked by a few insects, amongst which are :—

Anomala.
Termites.
Dorylus orientalis.
Gonocephalum elongatum.

Anomala grubs sometimes injure groundnut roots but we have no exact information about the species concerned or the real amount of damage done.

Termites also often attack groundnut below ground and may do a good deal of damage, but here again we want to know a great deal more about the species of Termites concerned—probably it is usually a species of *Microtermes*—and whether quite healthy plants are attacked or only those which are sickly or dying from other causes.

At Cawnpur Termites are bad on groundnut, and at times large patches are attacked. Crude Oil Emulsion is used with success in the irrigation water on the Cawnpur Farm.

Crude Oil Emulsion was used in the irrigation channel at Jhajhar, Rohtak District, Punjab, and putting the Emulsion in a bag, as is generally advocated, was found of no use. A man was then placed at the head of the channel to mix the Crude Oil Emulsion thoroughly with the water with his hands; this was found successful. At Jhajhar, Termites are so bad that groundnut cannot be grown there.

In the Hill Districts of North-East India oil-cake is put in pits before tea-plants are transplanted into them. This saves the plants from termite attack to some extent.

Dorylus orientalis was reported in June 1911 as doing damage to early-sown groundnut at Shahabad, Hardoi District, United Provinces. In this case termites were also implicated.

Gonocephalum elongatum has been reported from Cawnpur, the adult beetles being found on groundnut, but it seems doubtful whether the beetles were on the roots or were really doing damage.

NIGER SEED (*Guizotia abyssinica*).

[*Khorasan*—Hind.]

We have notes of a few pests on the leaves of Niger Seed :—

Agrotis flammatra.
Perigea capensis.
Plusia orichalcea.
Chrotogonus.
? *Pachnephorus.*

Agrotis flammatra seems to occur chiefly in the Punjab.

The caterpillars cut off young shoots in the Punjab.

We have already dealt with *A. flammatra* under gram. We want to know more about this insect before we can recommend any effective

control-measures, beyond of course such general methods as grubbing up the caterpillars.

Perigea capensis [" South Indian Insects," pp. 376-377, fig. 239] of which a coloured plate is now in the press, has been reared on Niger-seed at Pusa and in Madras, but is not much of a pest of this crop. We shall come to it again presently under safflower.

Plusia orichalcea has been found on Niger-seed at Pusa but is not a regular pest of this crop.

Chrotogonus attacks young plants especially and the ordinary control-method by bagging is applicable.

Mr. M. M. Lal. In the Punjab *Chrotogonus* and other grasshoppers do considerable damage to Niger-seed.

Mr. Fletcher. A small beetle, which is probably a *Pachnephorus*, is also reported from Nagpur as eating the leaves, but we do not seem to have much information about it.

SUNFLOWER (*Helianthus annuus*).

Sunflower was grown experimentally at Pusa some ten years ago but apparently was not a success. We have records of a few insect pests which attacked the plants then. That was before my time here and I do not quite know why the experiments were given up. Sunflower is grown extensively in some places, as in the South of Russia, for oil derived from the seeds, and I should have expected that it would do well in some parts of India. It is not grown, so far as I know, except as a garden plant but, if it should be taken up on any scale as an oil-seed plant in India, it will be as well to know what to expect in the pest line. You will find a short account of its pests in Pusa Bulletin No. 10 (" Treatment and Observation of Crop Pests on the Pusa Farm "), pp. 10-11, but we can add a few other insects to the list. On the leaves are found :—

Diacrisia obliqua.
Estigmene lactinea.
Amsacta lineola.
Tanymecus indicus.
Myllocerus 11-pustulatus.
,, *blandus.*

Diacrisia obliqua attacked sunflower very badly at Pusa in 1905. The plants were sprayed with Lead Arsenate with rather bad effects but later on the caterpillars were hand-picked with better results. The first lot of caterpillars are stated to have come onto the sunflower plants " after leaving the wild nettle on which they had been breeding " ; the moral of which would seem to be Clean Cultivation. In the case

of batches of eggs and young larvæ, whilst still gregarious, hand-picking should be done.

Estigmene lactinea and *Amsacta lineola* are also said to have occurred at Pusa in 1905 together with *Diacrisia*. Our collection contains a good many *E. lactinea* reared then, but no *A. lineola*, so that the latter record requires confirmation. The same treatment as for *Diacrisia* should afford control.

The weevils, *Tanymecus indicus* and *Myllocerus 11-pustulatus* and *blandus*, also occur on sunflower leaves but are scarcely pests.

Amongst sucking insects, we have a record of *Dolycoris indicus*, but this insect has a very wide range of foodplants and is scarcely a pest.

At Pusa the sunflower heads were bored by :—

Heliothis obsoleta.
Xanthotrachelus superciliosus.
" *faunus*.
" *perlatus*.
Stathmopoda theoris.

Of these, *Heliothis obsoleta* seems to have done most damage according to the Report which I quoted just now. The badly affected heads were picked off and those slightly affected were washed over with Crude Oil Emulsion.

The species of *Xanthotrachelus* also occurred in the heads but are not referred to in the Bulletin, as they were only recently identified, and I had a note on them in Bulletin No. 59, Note No. 27.

Stathmopoda theoris seems to be a mere rubbish-feeder and not a real pest.

SAFFLOWER (*Carthamus tinctorius*).

[*Kusum*—Hind.]

Safflower is grown to a considerable extent, partly for dye obtained from the flowers and partly for oil expressed from the seeds. In some districts, as in Bihar, the young leaves also are used as a vegetable. The plant is attacked by a few insect pests.

On the leaves we find :—

Perigea capensis.
Tanymecus indicus.

Perigea capensis is usually a minor, but occasionally a serious pest of safflower, eating the leaves and also the capsules. The insect is described and figured in "South Indian Insects," pp. 376-377, fig. 239 and a coloured plate [*exhibited*] is now in the press. When I was at Coimbatore we had rather a bad attack of this caterpillar on safflower

and sprayed with Lead Chromate without any success, but a subsequent spraying with Lead Arsenate was quite effective. Pupation takes place in the soil so that ploughing after removal of the crop is indicated to kill any pupæ in the soil.

Tanymecus indicus has been reported on safflower at Nagpur but does not seem to be a regular pest of this crop, although it is possible that it may at times damage young plants by nibbling the germinating shoots [see *Fauna of India, Curculionidae*, Vol. I, p. 100].

Mr. Khare. *Laphygma exigua* is sometimes a major pest of safflower in the Central Provinces.

Mr. Fletcher. The capsules of safflower are sometimes attacked by *Heliothis obsoleta*, which has been reared on safflower at Pusa, Coimbatore and Lyallpur. We have already dealt with this insect several times, and I do not think there is much more to be said about it in this connection.

A few sucking insects attack safflower :—

Dolycoris indicus.

Monanthia globulifera.

Aphids.

Dolycoris indicus ["South Indian Insects," pp. 470-471, fig. 347] is a very general feeder and is usually quite a minor pest of any crop on which it occurs.

Monanthia globulifera ["South Indian Insects," p. 486, fig. 371] sometimes occurs on safflower but is a very minor pest as a rule.

Aphids are sometimes bad. I saw a very bad attack of Aphids at Dharwar in February 1912. The species usually concerned is probably *Macrosiphum sonchi.*

Boring in the stem and shoots are a few flies but we know little about them.

Mr. Shroff. In Burma the shoots of safflower are attacked at Mandalay by fly maggots. I have brought some specimens [*exhibited*].

Mr. Fletcher. It seems to be quite a new pest. We do not know it at all.

We also have a record of a fly-maggot found in safflower stems at Mandla, in the Central Provinces, but I have not been able to get the species identified as yet.

Mr. Ratiram. In the Central Provinces there are two kinds of flies which attack safflower. In the case of one species the maggots bore into the stem and kill the plant; in the case of the other the maggots are found attacking the seeds on the plants.

Mr. Fletcher. There seem to be three dipterous pests of this crop but we seem to know remarkably little about any of them. None has been noticed at Pusa so far.

The next group of plants which we will consider includes the :—

MALVACEÆ.

The first which we will take is

COTTON (*Gossypium* spp.)

on which we find a very large number of insects, of which some are serious pests. We will take pests of cotton seedlings.

Cotton seedlings are attacked chiefly by grasshoppers and crickets. On our list I have :—

Brachytrypes portentosus.
Gryllodes melanocephalus.
Chrotogonus spp.
Epacromia tamulus.
Atractomorpha crenulata.
Laphygma exigua.
Thrips.
Atactogaster finitimus.

Brachytrypes portentosus has been dealt with in Vol. IV, No. 3 of our Entomological Memoirs. It is not especially attached to cotton but, when these crickets are present in large numbers and young cotton plants are available, considerable damage may be done. The predaceous wasp, *Sphex lobatus*, preys exclusively on this cricket and checks it to some extent.

Gryllodes melanocephalus seems to occur chiefly in the Punjab, at least as a pest, and has been reported as attacking young cotton plants in May and June as an occasional major pest. It is controlled by light-traps and the burning of fires at night at the corners of the fields.

Chrotogonus of various species occur everywhere and eat back the young seedlings ; they are best dealt with by bag-nets.

Epacromia tamulus [" South Indian Insects," p. 525, fig. 417] sometimes attacks young cotton plants. This grasshopper comes freely to light, and light-traps and fires may therefore be tried against it. It seems to be found throughout India, from Madras to the Punjab.

Atractomorpha crenulata is rather a minor pest of cotton. We shall come to it again, later on, under tobacco.

Laphygma exigua occasionally attacks cotton seedlings but is not a regular pest of cotton in India.

Thrips are sometimes found on young cotton but we seem to know very little about these insects.

Atactogaster finitimus [" South Indian Insects," p. 333, fig. 191] is a weevil which has appeared in Ramnad and Tinnevelly in October in some years and done considerable damage by devouring cotton seedlings.

I do not think there is anything to add to what has already been published about this insect.

Mr. Shroff. In Burma, at Mandalay *Brachytrypes*, *Gryllodes* and Chafers have done very serious damage to cotton seedlings, so much so that the cultivators had to grow *Sesamum* after the attack.

Mr. M. M. Lal. In the Punjab cotton seedlings are destroyed by *Chrotogonus* and *Gryllodes*.

Mr. David. In the United Provinces, grasshoppers do a lot of damage to cotton seedlings at Cawnpur.

Mr. Jhaveri. In Northern Gujarat *Amsacta moorei* does a lot of damage to early-sown varieties. The egg-masses are collected from the leaves and the caterpillars are hand-picked.

Mr. Ramakrishna Ayyar. *Atactogaster finitimus* does a lot of damage to cotton seedlings at Coimbatore.

Mr. Fletcher. We will go on to the insects found eating the leaves of cotton-plants. There is a long list, but most are unimportant as regular pests :—

Solenopsis geminata.
Sylepta derogata.
Phycita infusella.
Cosmophila erosa.
Diacrisia obliqua.
Estigmene lactinea.
Pericallia ricini.
Acontia graellsi.
,, *malvae.*
,, *intersepta.*
Tarache notabilis.
,, *nitidula.*
,, *opalinoides.*
Pelamia (Remigia) undata.
Euproctis fraterna.
Lithocolletis triarcha.
Bucculatrix loxoptila.
Atactogaster finitimus.
Myllocerus 11-pustulatus (maculosus).
,, *transmarinus.*
,, *discolor.*
,, *sabulosus.*
Tanymecus hispidus.
,, *princeps.*
Astycus lateralis.
Cyrtacanthacris ranacea.

Solenopsis geminata [" South Indian Insects," pp. 274-275, fig. 112] is an ant which perhaps we might have taken under " seedlings." It nibbles young leaves and buds and may do damage even to killing back young plants. It has also been noted to damage leaves and seedlings of brinjal, *Cajanus indicus* and *Ailanthus,* but does not seem to have been noticed on cotton outside of Madras.

Sylepta derogata [" South Indian Insects," pp. 434-435, tab. 35] occurs throughout India, Burma and Ceylon and is probably the most destructive pest of cotton as regards the leaves of the plant. On native cottons it is a minor pest, but exotic cottons are especially liable to attack and considerable damage may be done, especially in the case of experimental plots of new varieties. In such cases it can be dealt with by spraying with a stomach-poison but in the case of field-crops control is most efficiently done by removal of the rolled leaves or simply by squashing caterpillars in the rolled-up leaves on the bushes.

In the Punjab *Sylepta* is bad on the exotic varieties of cotton.

In Burma I have noticed the same thing.

In Bombay also it attacks the exotic varieties. The cultivators do nothing to check the pest.

Phycita infusella [" South Indian Insects," pp. 428-429, tab. 31] attacks the topshoots which wither and droop. It is a minor pest as a rule, occurring as a rule only on young plants, the insect disappearing when the flowers appear. The affected topshoots may be hand-picked.

Cosmophila erosa [" South Indian Insects," p. 391, fig. 257] occurs throughout India as a sporadic pest of cotton. As a pest it seems to occur chiefly in Western India, but we have records of this species on cotton from throughout Southern India, Dharwar, Poona, Jalgaon (Khandesh), Bassein Fort (Bombay), Surat, Ajmer, Narshingpur, Cawnpur and Pusa. It is not attached solely to cotton but has been reared from *bhindi* at Lyallpur, Pusa and Surat, and at Pusa from *Hibiscus cannabinus, Sida cordifolia,* hollyhock and *urid.* Like *Sylepta,* it seems to exhibit a marked preference for exotic cottons. The larvæ are best controlled by hand-picking.

Cosmophila is bad sporadically in Bombay. Cotton was very seriously attacked once in Khandesh and it was observed that the lower leaves suffered more than the upper ones. The caterpillars were parasitized by a Tachinid fly.

In the Punjab *Cosmophila erosa* is very common but it has never given us any trouble.

In Berar it was very serious in 1907. Hand-picking was done for four or five days, and Tachinid flies checked the pest afterwards.

Why was not hand-picking carried on? Was it not found successful? **Mr. Fletcher.**

Hand-picking was done only in the beginning but later on the crop grew very luxuriantly, because it had been manured with night-soil, and the coolies could not get inside the plot. **Mr. Ratiram.**

Has anyone noticed that *Cosmophila* attacks any particular varieties of cotton? **Mr. Fletcher.**

The variety grown in Gujarat is less attacked than the *neglectum* variety grown in East Khandesh. **Mr Jhaveri.**

Have you anything to say about the hand-picking of these caterpillars? **Mr. Fletcher.**

The caterpillars can be easily dislodged by shaking the plants and then the caterpillars which have dropped to the ground can be crushed. **Mr. Jhaveri.**

That is what I wanted to bring out. **Mr. Fletcher.**

Diacrisia obliqua sometimes attacks cotton in districts where it occurs and may do a good deal of damage when it is allowed to get out of hand. Prompt picking of eggmasses and young larvæ, combined with clean cultivation, should be quite effective checks.

Estigmene lactinea [" South Indian Insects," p. 368, fig. 230] is occasionally found on cotton but does not seem to be a regular pest.

Pericallia ricini [" South Indian Insects," pp. 370-371, fig. 232] has been reared on cotton in Madras but is not a pest of cotton.

Acontia graellsi [" South Indian Insects " pp. 385-386, fig. 249] is a very minor pest of cotton and is more commonly found on *bhindi*. We have records of its occurrence at Coimbatore on Cambodia cotton and at Shripur (Bengal) on cotton-flower. **Mr. Fletcher.**

Acontia malvæ may occasionally be found on cotton but we seem to have no records from cotton, so it is evidently of little importance as a pest.

Acontia intersepta also is not definitely known to occur on cotton but, as it feeds on *bhindi* and *Sida*, it may be found on cotton also at times.

Tarache notabilis occurs throughout the Plains of India as a very minor pest of cotton.

Tarache nitidula [" South Indian Insects," pp. 381-382, fig. 243] occurs commonly throughout the Plains of India and is an occasional minor pest of cotton.

Tarache opalinoides [" South Indian Insects," p. 382, fig. 244] occurs in Central and Southern India as a very minor pest of cotton.

All these species of *Acontia* and *Tarache* are potential rather than actual pests of cotton but may possibly occur sporadically as pests in the same way as *Cosmophila erosa*.

Pelamia (Remigia) undata has been noted at Nagpur on cotton as a very minor pest. It occurs more commonly on leguminous plants and is not likely to be much of a pest on cotton.

Euproctis fraterna occurs throughout India, Burma and Ceylon, and we have records of it as reared on cotton in Madras and at Lyallpur and Poona. It is a polyphagous species, not likely to be a regular pest of cotton but liable to occur occasionally.

Lithocolletis triarcha is a small Gracilariad moth whose larva mines cotton leaves. It has only been noticed at Pusa so far as I know and can hardly be looked on as a pest.

Bucculatrix loxoptila is a small Lyonetiad moth which was reared at Attur, Madras Presidency, in June 1907 from larvæ found eating small holes in leaves of *Caravonica* cotton. It has not been noted in India since then or from any other locality, but I call your attention to it because it is possible that it may prove to be a pest. This species was only described comparatively recently by Mr. Meyrick [*Exotic Microlepidoptera*, I., 209] but it was described from examples sent from Zanzibar, where the larva was found damaging cotton. Whether it was introduced into Zanzibar from India or *vice versâ*, or whether it is a widely distributed species, we do not know, but certainly in Zanzibar it has proved a pest and we have it occurring in India, so it may turn up here also as a pest. I might add that in a recent number of the *Journal of Economic Entomology* you will find an account of an allied species, *Bucculatrix thurberiella*, which has recently been noted as a pest of cotton in California. So that if you find a small caterpillar eating holes in the leaves of cotton in India we should like to know more about it.

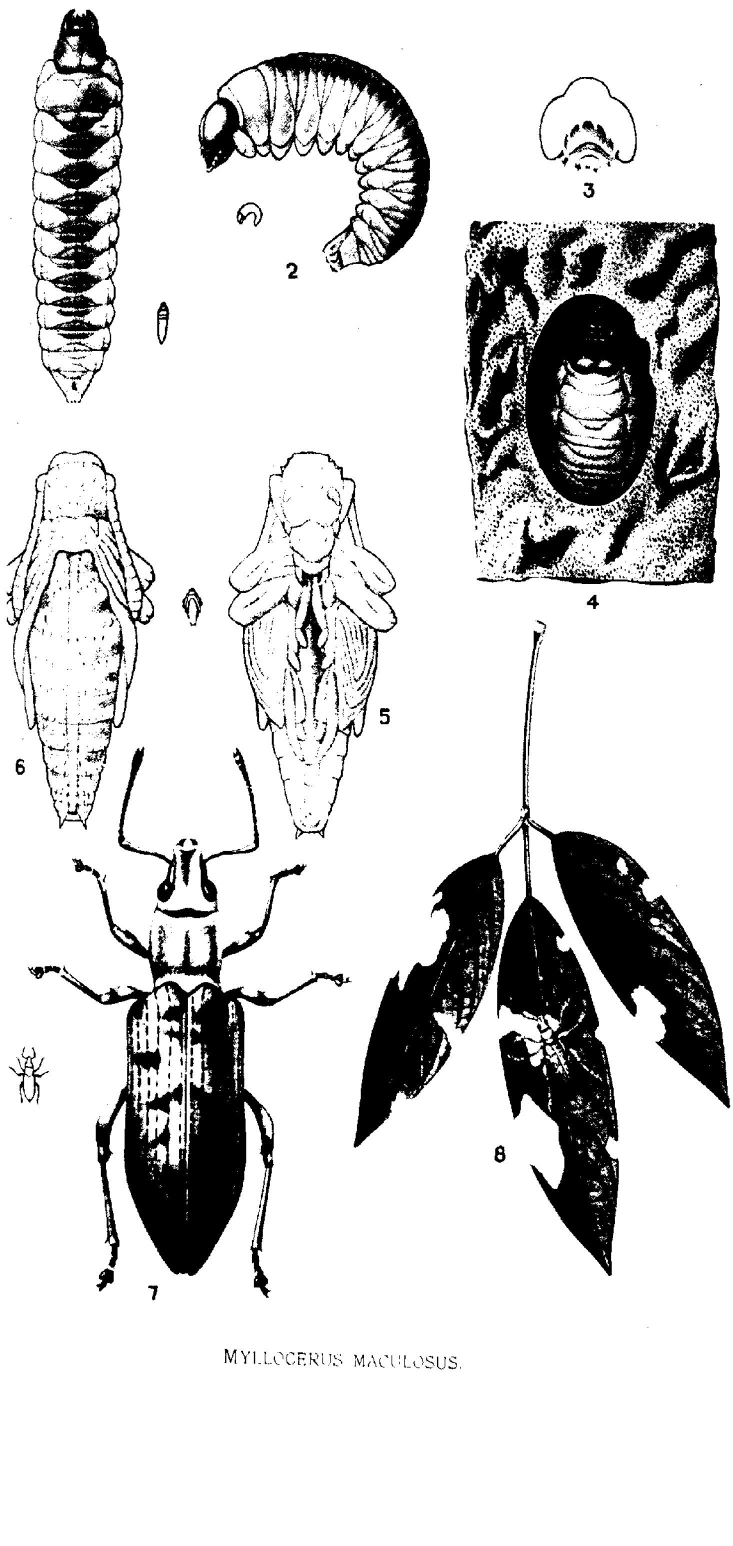
Atactogaster finitimus we have just dealt with under the head of seedlings, but it sometimes injures the leaves of more mature plants as well.

Of the species of *Myllocerus* on our list, *M. transmarinus* [*Fauna of India, Curculionidae*, Vol. I, p. 337, fig. 102] seems to be attached especially to *Zizyphus* and *Dalbergia* but has also been found on cotton at Pusa, doubtless as a mere casual visitor ; *M. discolor* [*Fauna of India, Curculionidae*, Vol. I, p. 348, fig. 106] is widely distributed in India and has a wide range of foodplants and has also been found at Pusa on cotton, but is not a pest so far as we know ; *M. sabulosus* [*Fauna of India, Curculionidae*, Vol. I, p. 336] occurs throughout Madras, Bengal and the United Provinces on *Zizyphus* and *Casuarina* and has also been noted at Pusa as a casual visitor on cotton.

Myllocerus 11-pustulatus, under which name is included the variety *maculosus*, Desbr., is common throughout India on a large variety of foodplants and is often abundant on cotton, of which it is a regular

Myllocerus 11-pustulatus (maculosus).

Figs. 1 and 2 show the grub, and
Fig. 3 the hind end of the same;
Fig. 4 shows a pupating grub inside the pupal cell;
Figs. 5 and 6 are the front and the back views of the pupa;
Fig. 7 is the adult weevil enlarged, and
Fig. 8 is the same, natural size, eating a pigeon pea leaf.
Outline figures show the natural sizes.



MYLLOCERUS MACULOSUS.

minor pest. Its lifehistory is shown on a coloured plate issued last year. The most effective control is by shaking the weevils off the affected plants onto cloths or into trays and then dropping the catch into oil and water.

Tanymecus hispidus, Mshll. [*Fauna of India, Curculionidae*, I, p. 98, fig. 24, *t*.] is known from Bihar to the Punjab and has been found on cotton at Rohtak, but it is of no importance as a pest of cotton.

Tanymecus princeps, Fst. [*Fauna of India, Curculionidae*, I, 97, fig. 24, *l*.] occurs from Bengal to Surat and North Kanara. At Surat it was found on cotton leaves, but we do not know it as a pest of cotton.

Astycus lateralis is sporadically abundant at Pusa on cotton and has also been found on cotton at Cawnpur and Nagpur. It appears to be universally distributed throughout India and Burma but does little damage to cotton as a rule. Control, when abundant, as in *Myllocerus 11-pustulatus*.

Cyrtacanthacris ranacea ["South Indian Insects," pp. 530-531, fig. 424] is common in cotton fields thoughout India and undoubtedly does some damage at times by eating the leaves, but it is scarcely a pest. When sufficiently common, it can be caught in bags or hand-nets.

In Nadiad there is a grasshopper which is a sporadic pest. It occurred in 1913 and 1914. I am not sure of its identity. **Mr. Jhaveri.**

The flowers of cotton are attacked and eaten by various Meloid and Cetoniad beetles. The habits of all are very similar as regards damage and when in sufficient numbers they can be collected by hand or in hand-nets. **Mr. Fletcher.**

We will take next the insects injuring cotton buds :—

Dasyneura gossypii.
Gelechia gossypiella.
Earias fabia.
,, *insulana*.

Dasyneura gossypii was originally brought forward as a cotton-pest in India in "South Indian Insects" where it is described and figured, pp. 363-364, fig. 223, as *Contarinia* sp., and it has since been described [*Canadian Entomologist*, 1916, 29-30] by Dr. Felt as *Dasyneura gossypii*. I do not think there is much to add to the account already given. This species has only been noted so far at Coimbatore, the larvæ boring in the buds which wither and fail to expand. It is probably widely distributed in India but is easily overlooked, so I draw your attention to it.

This gall-fly occurs in Mysore also in cotton-buds. **Mr. Kunhi Kannan.**

Gelechia gossypiella and the species of *Earias* also damage the flower-buds of cotton but we will consider them under the heading of Bolls. **Mr. Fletcher.**

Attacking the bolls and seeds of cotton we find :—

Earias fabia
,, *insulana.*
Gelechia gossypiella.
Anatrachyntis simplex.
Heliothis obsoleta.
Dysdercus cingulatus.
Oxycarenus lœtus.
Alphitobius piceus.

Both species of *Earias* have acquired a considerable economic literature in India. The latest account is given in " South Indian Insects," [*Earias insulana*, pp. 384-385, tab. 22 ; *E. fabia*, p. 385, tab. 23]. In Southern India *fabia* is rather commoner ; in the Punjab *insulana* is much commoner than *fabia* in the Western Districts, but in the Eastern part of the Punjab *fabia* and *insulana* seem to be equally common. The damage done, however, is identical. In the aggregate both species must cause an immense loss to the cotton crop of India, but it is in the Punjab that this damage is most pronounced, and in some years it is very serious indeed running into a loss of several million pounds sterling. As the Punjab is so much concerned, perhaps Mr. Madan Lal will tell us about *Earias* in that Province.

In the Punjab *Earias* (both species, but principally *E. insulana*) attacks the cotton plant every year. In some years the attack is more serious than in others. We have not worked for many years on this pest but the observations made so far show that there are two factors which exercise a check on its abundance, namely, the early monsoon rains and the presence of the parasite. If we have early monsoon rains in June and July, the early broods are destroyed more or less as the affected buds and flowers drop down onto the ground.

But are not the larvæ found boring in the shoots during the early stages of the attack ?

They do attack the shoots but not to the same extent as they do the buds and flowers. The rain has an effect only on the affected buds and flowers which fall off the plants especially after a heavy shower of rain.

In the later stages of growth of the plants, in August and September, the severity of the attack depends on the presence or absence of the parasite. If the parasite is present in the field, then the attack is less ; if the parasite is absent, then the attack is more.

Can you give us any *data* regarding the factors controlling the abundance of the parasite ?

I cannot say anything very definite as to the conditions under which we find more or less parasites. But their occurrence generally depends on the preceding winter. If the winter is severe, it seems to affect the parasites and in the following summer their numbers are less. **Mr. M. M. Lal.**

In that case the control of the bollworm can be attained by reintroduction of the parasites. This has been done to some extent, I know, and we have sent living parasites (*Rhogas*) from Pusa to the Punjab during the last two years with this object in view. Can you tell us what has been done in this line in the Punjab? **Mr. Fletcher.**

We receive the parasites from Pusa in June and July and liberate them in the parasite-breeding plots and in this way we get them established by the time the cotton is in boll. The parasites do not seem to attack the bollworm in the buds and flowers quite to that extent as they do when the caterpillars are in the bolls. When the parasites get well established in the parasite-breeding plots, we remove the affected bolls and place them in parasite boxes which are sent out and placed in badly affected cotton-fields. But, before despatching, we make absolutely certain that the parasite boxes contain the parasites in them. **Mr. M. M. Lal.**

About what date do you have these parasite boxes ready for distribution in the affected fields? **Mr. Fletcher.**

By the second week in August we get the parasites established and from that time onwards we begin to distribute them, until about November. **Mr. M. M. Lal.**

How is the distribution of these boxes carried out? **Mr. Fletcher.**

We train a number of Agricultural Assistants to help us in the work of distribution of the parasite boxes in the districts. Last was the first year in which we distributed these boxes on an extensive scale throughout the Punjab. We took up this work in four districts in which the Agricultural Staff was able to carry it out. The first lot of parasite boxes was sent out from Lyallpur to each of these districts, in which it was placed in bollworm-affected cotton-fields and left for a fortnight; at the end of that time, affected cotton-bolls in the adjacent area were collected and placed in other parasite boxes and distributed further. Each District Staff was given one hundred of the parasite boxes and these were used over and over again, because all the parasites leave them within fifteen days. When the parasites were established the boxes were refilled with bollworm-affected bolls and distributed again. **Mr. M. M. Lal.**

Were these secondary sendings of boxes, sent out by the District Agricultural Staffs, examined to see that they actually did contain the parasites? **Mr. Fletcher.**

You cannot always be sure of that because the District Agricultural Staff is not trained to do this. But we take care that several of the primary plots do contain the parasites; we examine the affected bolls and see that the parasites are present. We have to take our chance as to whether the parasites are present in the boxes sent out from the secondary plots.

Have you any *data* regarding the percentage of bollworm attack before and after the use of these parasite boxes ?

Last year it was taken before the boxes were placed in the fields and we obtained the percentage in some cases. It was fairly high and showed a tendency to go higher, from 15 per cent. to 20 per cent. and from 20 per cent. to 25 per cent., and figures like that. That was before we used the parasite boxes. After the parasite boxes were used, the percentage of attack remained constant for some time and then slowly began to decrease. Of course, it was impossible to get exact figures.

How did you obtain the figures you have given ?

One can easily take the percentages from plots in which the parasites have been liberated and compare them with those of areas in which the parasites have not been introduced.

How many boxes did you use ?

About 2,000 boxes were used altogether. Each District Assistant was given 100 boxes which he used five or six times over. Actually about 400 boxes were in use at one time.

You really think that the parasite-boxes did good work ?

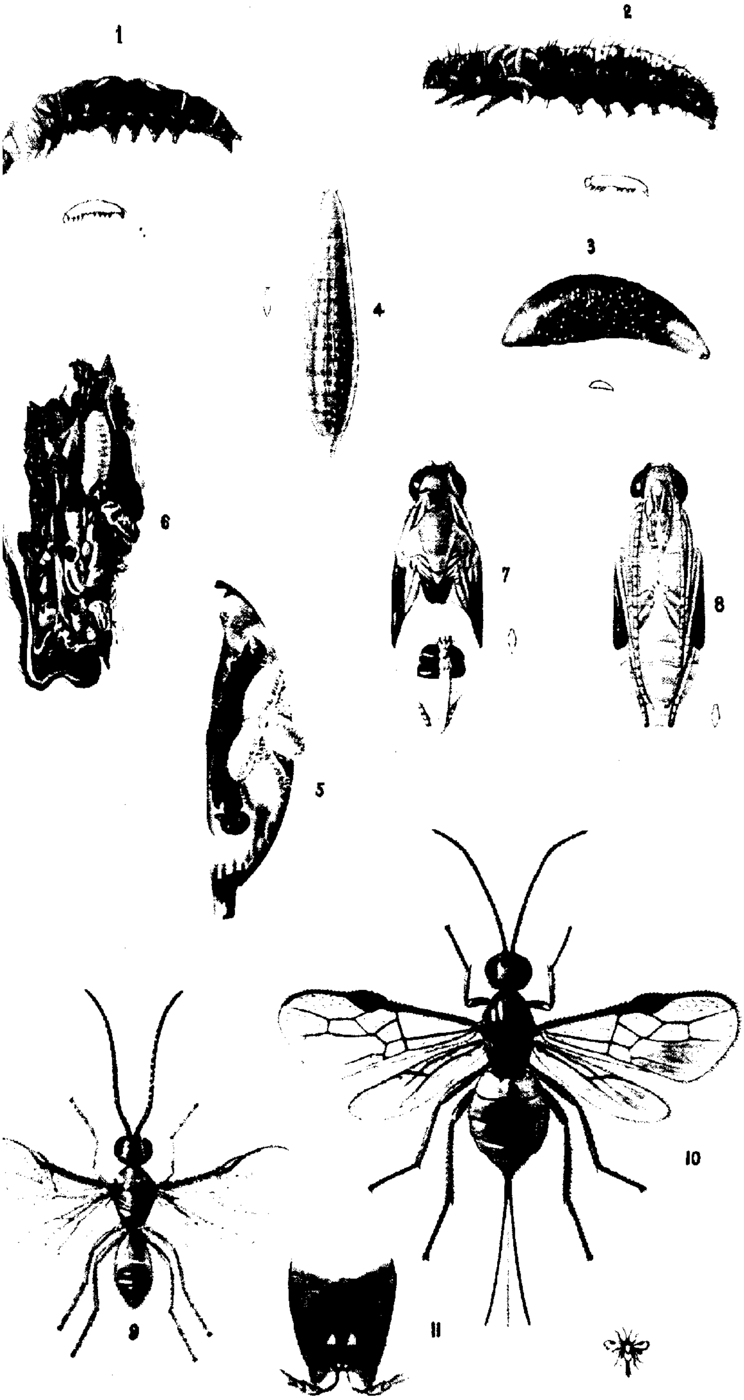
The conclusion we have arrived at is that by the use of the parasite-boxes the attack of bollworm is generally lessened. Where the parasite-boxes are not used, the attack is always bad.

I think that a great deal more investigation is required before we can say much definite about the real value of these parasites. Our experience at Pusa, in breeding these parasites under the most favourable conditions, in special plots which are kept full of *Earias*, is that the percentage of parasitization is extremely low, less than 10 per cent. in the case of cotton and only about 12 per cent., rising to 21 per cent. at the most favourable time of the year, in the case of bollworms feeding in *Hibiscus abelmoschus*. If the percentage of parasitization is so low it is difficult to see how so great an effect on the bollworm attack on cotton can follow the liberation of the parasites. The conditions may, of course, be different in the Punjab but, as I just said, we want to know a great deal more about this matter.

Another point is the identity of the parasites concerned. When this work was first taken up it was supposed that there was only one species of *Rhogas*, *R. lefroyi*, parasitic on *Earias* in India. A closer examination

Rhogas sp.

Fig. 1. Eggs laid singly on a caterpillar.
Fig. 2. Young larvæ feeding on the body of a caterpillar.
Fig. 3. A full-grown larva, side view;
Fig. 4. A nearly full-grown larva, dorsal view;
Fig. 5. Cocoons;
Fig. 6. Cocoons from which the adults have emerged;
Fig. 7. Pupa of a female, dorsal view;
Fig. 8. Pupa, ventral view;
Fig. 9. Adult, male;
Fig. 10. Adult, female.
Fig. 11. Middle part of Thorax (meso-sternum) of female; ventral view.
All figures are magnified; the outline sketches show the natural sizes.



RHOGAS LEFROYI.

of the material available shows that we have apparently at least five distinct species of *Rhogas* parasitic on *Earias fabia* and *E. insulana*. Of these, one is probably *Rhogas lefroyi*, another is apparently identical with *R. kitcheneri*, described by Dudgeon and Gough [*Agric. Journ.* Egypt, III, p. 108] from *Earias insulana* in Egypt, and the other three are probably undescribed species. We have sent specimens to Washington to Mr. Brues for exact identification, but this has not been received yet. Of course, the fact that more than one species of *Rhogas* is concerned is not a matter of interest merely from the systematic point of view; it is a matter of some moment in considering this question of parasitization of *Earias* by *Rhogas* and it complicates the question immensely. Here again our present knowledge is very defective. We want to know which of these species are concerned as effective checks on *Earias* (if any of them are). It may turn out that only one is really important and, if so, we want to know which one. Then there are other points. For example, in the very same number of the *Agricultural Journal of Egypt* in which Dudgeon and Gough described *Rhogas kitcheneri* they note that it was also bred in Egypt as a parasite of *Ephestia cautella*. Does any *Rhogas*, effective in India as a check on *Earias*, parasitize any other common insect on which we can breed it more readily than on *Earias*? At present we do not know, but a more thorough investigation of the subject might well bring to light many facts of this sort which could be utilized. I may add that the coloured plate, issued under the name *Rhogas lefroyi*, shows a *Rhogas* which does not agree with the description of *lefroyi* as given by Dudgeon and Gough and it is probably a distinct and undescribed species, although we have specimens from Lyallpur which agree fairly well with the description of *lefroyi*. I may also call your attention to the fact that this is one of the numerous cases in which systematic work must form the very foundation of any applied work in economic entomology.

Besides the use of parasites, have you tried any other methods of control of cotton bollworm in the Punjab?

Mr. M. M. Lal. Handpicking of the affected buds, flowers and bolls used to give the best results but experience has shown us that it is a very tedious measure to adopt on any large scale, and it is very difficult to induce people privately to handpick their affected plots. They prefer to have bad cotton rather than none at all. For the last two years we have been making some experiments by mechanical aid, shaking the plants by dragging a rope over them and irrigating the field afterwards. Cotton is mostly grown in irrigated areas. Dragging a rope over the top portions of the plants gives very much the same effect as a strong gust of wind will give. The idea is that all the affected buds and flowers will drop

down when the rope is drawn over the plants. After that, when the field is irrigated, this gives the same effect as a shower of rain. In this way we reduce the attack in the early stages. When we irrigate the field, the attacked buds and flowers drop and rot in the standing water; we have collected many of these fallen buds and flowers and found the bollworms inside, and these bollworms are drowned in the irrigation water. By this means a large area can be gone over with comparative ease.

What time of year do you do this?

In the Punjab cotton is generally sown in March and it remains in the field until November or December. We get a number of buds in May, but the cotton-plants are not much attacked before June or July, after which bolls begin to be formed. It is therefore when the later buds and flowers are present, in June or July according to locality, that this control-measure may be carried out.

At this stage of the discussion it seems desirable that a few words may be said as to the facts which led to the idea of shaking the cotton plants artificially and then submerging the fallen affected buds and flowers and bolls by irrigating the area.

In the year 1911 there was a bad outbreak of the Cotton Bollworm in the Punjab, and I had the good fortune of having been deputed there by the Imperial Entomologist to study the pest. I reached there in the last week of August and started forthwith three experimental plots:—

(1) the "treated plot," *i.e.*, the plot from which all affected buds, flowers and bolls were periodically picked off and destroyed,

(2) the "untreated plot," *i.e.*, the plot which was left to itself and in which no remedial measures were adopted against the pest,

(3) the "parasite breeding" plot, *i.e.*, the plot in which the parasites of the cotton bollworm were encouraged.

The next step taken was to ascertain the condition of these plots from an entomological view-point and for this the following method was devised:—

> Two central rows of cotton plants were selected in a field; all the buds, flowers and bolls on a plant (commencing from one end) were counted and then the number of damaged buds, flowers and bolls on the same plant was noted. The next plant in order was then dealt with similarly. This operation was continued till the total number of buds, flowers and bolls examined reached up to 2,000 or so. Loss percentage was finally calculated.

In this way on 26th August 1911 the loss percentage in the plots selected for experiments was determined and it was found to be nearly 25 per cent. On the night of 30th August 1911 at about 10 o' clock a terrible dust-storm moving with a tremendous velocity passed over Lyallpur. The houses were shaken to their very foundations and no tree was left uninjured in the station. The storm was followed by a heavy shower of rain which was recorded as over two inches and a half in the town. On the following morning, *i.e.*, 31st August, the loss percentage in the plots had to be ascertained again, and it was found to have fallen down to 9 per cent. in one and to 11 per cent. in another. Several countings were made but with the same results. This evidently showed that the storm accompanied by heavy rain on the night of 30th August had some beneficial effect on the standing cotton crop at Lyallpur. My detailed observations on this point have convinced me that some connection does exist between heavy rainfall and decrease in the number of Cotton Bollworms. I shall try to explain now how it happens.

It is a well known fact that buds, flowers and newly-formed bolls of cotton affected by the Bollworms wither and fall off the branches. I have seen that in case they remain on branches a mere touch of the hand or a rough shaking of the branch is sufficient to make them drop to the ground. Now when a storm blows over a cotton field on which the standing plants bear 25 per cent. damaged buds, flowers and bolls on them, the result will be that a major portion of the injured buds and flowers will be thrown off the plants. Again, the Bollworms from these fallen buds will crawl out and climb on to other healthy plants near which they may happen to lie and thus intensify the damage. But matters will be different if soon after the storm there should be a heavy rain. If the soil is not very pervious water will stand in the field and drown all the fallen buds and flowers. The worms inside them will either get suffocated and die or get wet and develop some fungus growth which will prove fatal to them. Some caterpillars leave the buds and flowers and, being unable to get to other plants, die.

To inquire into this point further, I visited certain places which had experienced similar atmospheric variations on the night of 30th August 1911. I calculated the damage due to Bollworm in those localities to be between 9 and 10 per cent. There was nothing authentic on record to show to what extent the plants were damaged prior to the advent of the storm and rain, consequently I had to rely on the results of local enquiry. The Zaildars and Lambardars assured me that the loss was much greater before than at that time.

One point more to make my views clear on the subject. The small caterpillars on hatching out from the eggs feed (1) inside the cotton

shoots which wither and turn brown, (2) in the buds which wither or fall off to the ground, (3) in flowers which also wither and fall and (4) lastly inside the bolls which they destroy by eating the seeds and filling them with excrement, but when newly formed bolls are attacked, these also drop to the ground. Thus it is clear that there are three stages in the growth of the cotton plant when caterpillars are likely to be thrown off the plants if the branches are shaken, either naturally as during a storm and a heavy shower of rain, or by artificial means. These stages are (1) when the plants are throwing out buds or (2) flowers and (3) when flowers are just turning into bolls. The affected buds, flowers and newly formed bolls fall to the ground and with them the caterpillars which feed inside them. The caterpillars which are inside the shoots or inside such bolls as are in advanced stages of growth, are not at all affected this way, for the storm " may bend but shall never break " the tender shoots, and the large sized bolls have the stalk sufficiently developed, which keeps them firm and intact on the branches.

Thus it will be seen that according to this theory the good resulting from rain is governed by three factors :—First that a heavy rain should follow a wind storm, secondly that this should happen at a time when the bollworm is chiefly in the cotton buds, flowers and young bolls; and thirdly the soil should not be very pervious. When and where these three circumstances combine the cotton crop is bound to be benefited.

In the South-West Punjab the annual rainfall is poor and is very scanty during the summer months; but the land is visited by rather frequent dust-storms during this period of the year. The cotton crop there is grown under irrigation and there is no dearth of water on account of the excellent canal system. The cultivators get water for their areas according to turns which have been fixed by the Canal Authorities. But if the cultivators could get water for irrigating their fields just after a heavy wind-storm the effect produced would be very similar to a heavy shower of rain succeeding a storm and consequently would be beneficial to the standing crop. This appears to be rather difficult to arrange as there would be considerable technical difficulties put forward by the Irrigation Department. The next best step thought of, therefore, was to produce artificially the same effect as that of a wind storm by artificially shaking the plants just before irrigating them. And this is quite possible. I had to return to Pusa and as winter had set in I had to mention it in my report only as a suggestion of line of work to be taken up next year, by the Assistant Professor of Entomology, Agricultural College, Lyallpur. I am glad to learn that he did take up this line of

inquiries, and the results of his experiments and observations you have just now heard from him.

Mr. Fletcher. We have heard a good deal about *Earias*, but there is one other line of work that we have been doing at Pusa and that is the question of relative intensity of attack on various kinds of cotton. We have got cotton of various kinds from practically all cotton-growing tracts in India and have been growing them here in parallel rows and keeping careful counts of the relative amount of infestation, whilst several species of *Hibiscus* and other malvaceous plants have also been used for comparative tests. The figures of these trials are not yet ready and I think it is rather early to discuss them, as the experiments require to be repeated and checked, but the question of immune varieties is one that you might keep before you in considering the control of pests such as Cotton Bollworm.

Has anyone anything more to say about *Earias fabia* or *E. insulana* ?

Mr. Ramakrishna Ayyar. How are the living parasites sent from Pusa to the Punjab ?

Mr. Fletcher. They are sent in small postal boxes [*a specimen exhibited*] made of strong cardboard pierced with small holes, such as are used for sending out silkworm eggs. The boxes are lined with fine muslin or gauze and inside the boxes are placed the newly-formed cocoons of the *Rhogas*. The affected cotton-bolls or *Hibiscus* pods or shoots are collected and cut open and the *Earias* larvæ taken out and those which are parasitized are kept until the parasitic grubs have spun up ; they spin up on pieces of paper or on the bracts of the affected bolls or similar material and the cocoons are removed, together with the surrounding material to which they are attached, and this is suspended in the box by threads. The pupal period is about five to seven days, according to temperature, and the adult flies may emerge in the boxes on the way but are kept in by the gauze lining and usually reach in a living condition.

If the affected bolls are sent by post, we find that the result is not satisfactory, as the weight of the bolls crushes the *Earias* larvæ and any adult *Rhogas* which may emerge *en route*.

The unparasitized *Earias* larvæ are reared out and the moths liberated in the breeding plots to provide host-material for the parasites.

Mr. Fletcher. *Gelechia gossypiella* [" South Indian Insects," p. 454, tab. 42] occurs throughout the Plains of India, Burma and Ceylon as a pest of cotton, serious in most localities, especially so in the United Provinces, Punjab, and North-West Frontier Province. In all districts exotic varieties seem most subject to attack. The larva bores into the bolls, feeding on the seeds and spoiling the lint, and also does some damage to buds and flowers when bolls are not available, but when bolls are formed these are much preferred. Many of the attacked bolls drop off and

there may be considerable loss of crop from this, or the bolls open prematurely and the fibre is short and comparatively useless. The oil content of the attacked seed is seriously lessened also and the germination is also affected if the seeds are used for sowing.

Gelechia gossypiella was first described from India in 1842 and is probably endemic in India. It has since been introduced into other cotton-growing areas and has proved a serious pest, apparently worse than it is in India as a whole. It was apparently introduced into Egypt about ten years ago, probably in so-called ginned cotton (containing a high proportion of seed) imported from India. In Egypt it has spread and increased until it has become a most serious pest of the Cotton crop. A most voluminous Report on its occurrence in Egypt has recently been issued by Mr. F. G. Willcocks, a large quarto volume of over 300 pages on this one insect. It is impossible to summarize this now but the book is placed on the table and I recommend those who are interested to have a look through it.

Gelechia gossypiella has also been introduced into Hawaii and has proved a pest to cotton there also, and a good deal has been written about it. One interesting fact is that Mr. Fullaway has reared *G. gossypiella* in Hawaii from *Thespesia populnea*, which is a common tree in India and may perhaps serve as an alternative foodplant here also. Anyway, I draw your attention to the possibility of this.

G. gossypiella is attacked by a good many parasites. In India a Braconid was reared at Surat and is figured in "Indian Insect Pests" [p. 95, fig. 107] under the name *Urogaster depressariæ*, but I think that is only a manuscript name of Ashmead's, never published. *Rhogas*, whether of one or more species or of which species, I cannot say, has also been reared in India from bolls attacked by *G. gossypiella* but possibly *Earias* may have been present also. In Egypt Willcocks has given, pp. 233-269 of his Report on Pink Bollworm, a list of the parasites met with, and in Hawaii Swezey has listed the parasites of this species [*Proc. Ent. Soc. Hawaii*, III, pp. 101-109.] This is a subject on which we want to know more in India.

Another subject on which we require more information is the various alternative foodplants on which *Gelechia gossypiella* may breed in India. Our series includes examples reared from cotton buds, flowers and seeds from various localities in India and also specimens bred at Pusa from *Hibiscus abelmoschus*, and also one Pusa specimen labelled "on hollyhock." Whether this last was bred or not I cannot say; it is an example of the inconclusive information to be derived from an incomplete method of labelling, about which I spoke in my opening address to you. Amongst other likely food-plants are other species of *Hibiscus*, *Abutilon*, *Sida* and

Bombax. It will add to our knowledge if any of you can discover additional food-plants of *G. gossypiella* in India. One use that we can make of such a knowledge is to use such alternative food-plants as trap-crops, but that is not a method which is likely to be of much use in India on any scale because there is a great danger that the trap-crop will not be destroyed either at all or at the right time. Another way in which such a knowledge will be useful is this—that if we find any wild plant, such as *Sida* or *Abutilon*, acting as an alternative host-plant when cotton is not in the ground, we can destroy such plants and thus help to reduce the numbers of the pest. With regard to this, however, in the case of *G. gossypiella* we must bear in mind the possibility of a very long resting period of the larvæ in cotton-seed. In my opening address I called your attention to Willcocks' experiment in Egypt when larvæ from infested bolls collected in November 1913 gave rise to moths as late as the end of August 1915. These observations may not hold good in India but here again we are faced by our want of exact knowledge of the life-history of the insect concerned, and here again you can all help to fill up this gap in our knowledge. Meanwhile we shall be on the safe side if we assume that the same conditions hold good in India as in Egypt and that the pest can be carried on from year to year, or even from one year to the *second* year thereafter, by resting larvæ in (*a*) the fields themselves, *e.g.*, in old dropped bolls, fragments of cotton plants, etc., in the soil, (*b*) the newly-sown seed, whilst it is also quite possible that the insect may also carry on breeding in the off-season for cotton in *Hibiscus* spp. and hollyhocks and perhaps in wild malvaceous plants such as *Sida* spp., *Abutilon indicum*, and *Thespesia populnea*.

Control must therefore provide for all these means of perpetuation of the pest, and may be divided up roughly into the following headings :—

(1) *Cultivation Methods.*

(*a*) Removal and destruction of all old broken, worthless bolls before and during the harvest period. Frequently these are left on the bushes as not worth picking, or if picked are thrown away, thus providing suitable breeding places for *Gelechia*.

(*b*) Thorough removal and destruction of old bushes and all fragments of same immediately after harvest. Goats and sheep, if turned into the fields, will help in destroying any bolls left after last picking.

(*c*) Removal from adjacent areas of all wild or cultivated malvaceous plants which serve as alternative food-plants for

Gelechia. This is especially necessary when cotton is not available for food.

(*d*) Irrigation of areas which have been under cotton, if practicable, in spring after crop has been removed. If the soil is wetted when the temperature is high, many larvæ resting in the ground are induced to abandon the resting-stage, come to the surface, pupate and emerge as moths.

(*e*) Early maturing varieties are less exposed to attack, and sowings should therefore be made as early as possible.

(2) *Methods for use with seed.*

If infected seed is sown, subsequent infection of the resulting crop can only be expected. It is therefore of importance to destroy the resting larvæ in the seed before sowing. This can be done in various ways :—

(*a*) For *small* quantities immersion for 5-10 minutes in hot water (130° F.) is efficient.

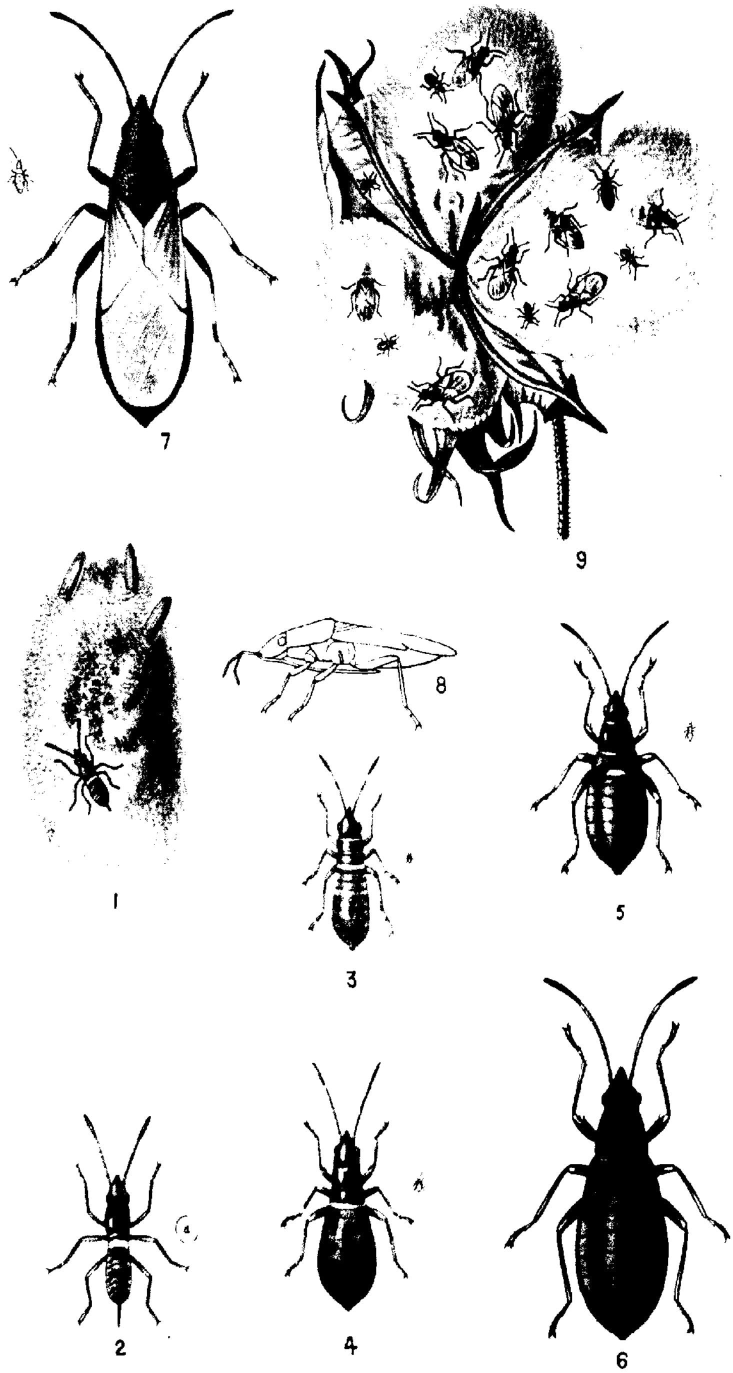
(*b*) Exposure to Sun's heat (about May, when really hot) is effective for *small* quantities *spread thinly* so that every seed is reached. A temperature of 50° C. for a short time is fatal to the larvæ.

(*c*) Fumigation with Carbon Bisulphide or Hydrocyanic Acid gas is also effective, but a proper vacuum apparatus is really required to attain the best results and fumigation is hardly possible to the cultivator. In the case of Agricultural Stations, where fumigation could be applied to seed on a large scale, in combination with the issue of pure seed to the cultivators, this method deserves trial in India.

(*d*) Storage of cotton seed (either surplus after sowing, for crushing, or for running and setting gins) is a highly dangerous proceeding.

Anatrachyntis simplex has been bred from cotton-bolls on various occasions but, so far as I can make, is merely a rubbish feeder and not a pest. It is referred to in "South Indian Insects," pp. 158-159, fig. 331, under the name *Pyroderces coriacella*, but Mr. Meyrick has since then founded the genus *Anatrachyntis* as separate from *Pyroderces* and Lord Walsingham has informed me that he has re-examined his type of *simplex* and considers that it is identical with *coriacella*, Snellen ; so that both names of this species have been changed.

Anatrachyntis falcatella has also been bred at Pusa from cotton shoots but this also is probably a rubbish feeder and not a pest of cotton.



OXYCARENUS LÆTUS.

Oxycarenus lætus, Kby.

Fig. 1, a cotton seed (enlarged) from which the lint has been removed to show the eggs; there is one newly hatched nymph on it.

Figs. 2 to 7 show the development of the nymph into the adult bug.

Fig. 8, a side view of the adult bug in outline.

Fig. 9, an open cotton boll with bugs on it.

All figures are magnified. The small outline figures show the natural sizes.

Heliothis obsoleta has attained notoriety in America as *the* cotton boll-worm of that part of the world, but it is very curious that in India it has never been noticed as a cotton pest. It does occur on cotton, but rather as a curiosity than as a pest, and that is about all we can say about it. It has been reared at Pusa on cotton-bud and cotton-boll, at Khandesh and Dhulia on cotton-buds, at Nagpur on cotton-boll. It is curious and interesting to find this great difference in its preference for food exhibited by this insect in India and the United States, but we shall come to a parallel case when we come to consider *Phthorimæa operculella* which attacks stored potatoes in India but has never been noticed on tobacco leaves, although in North America and South Africa this same insect is well-known as a pest of tobacco in the field. Facts of this sort require to be borne in mind especially when we come to consider the results which may follow on the introduction of insects into new countries or localities.

Dysdercus cingulatus ["South Indian Insects," p. 484, tab. 46] occurs everywhere in India and Burma and is sometimes a serious pest of cotton. It is found on numerous other malvaceous plants, *Hibiscus*, *Abutilon*, *Althæa*, *Thespesia*, *Bombax*, etc., and often occurs in very large numbers, the immature nymphs clustering in masses and forming masses of vivid scarlet conspicuous at a great distance. When found in masses like this they are fairly easily dealt with by spraying, squashing, or burning them *en masse*. On cotton plants they can be collected by shaking into trays or into the tin funnels, fitted with a bag, as used in the West Indies. They may also be attracted to collections of cotton-seeds placed among the cotton-plants, and large numbers may be obtained in this way. If the seeds are wrapped in wire gauze or wire-netting, it makes it more convenient, as the mass of seeds can be picked up and the bugs shaken off.

As regards the actual damage done, we require to know more. The bugs suck the seeds and must damage them as regards their oil-content. Last year we experimented with *Dysdercus* on *Bombax* seeds as regards the effect on germination, but the experiments were a failure, as all the seeds, both those sucked by the bugs and the clean, unsucked seeds kept as controls, all equally failed to germinate.

Mr. Jhaveri. In Bombay *Dysdercus cingulatus* is found everywhere. At Poona cotton-seeds were soaked in water for a few hours and then enclosed in muslin bags, which were placed here and there amongst the cotton-plants. These bags attracted large numbers of bugs which were shaken off into a vessel containing kerosine oil and water and the bags put down again.

In the Punjab, at Lyallpur, this bug is found congregating in large numbers on fallen leaves during the early hours of the morning. These can be collected and destroyed.

Oxycarenus lætus [" South Indian Insects," pp. 482-483, fig. 367] is a minor pest of cotton, usually occurring on old open bolls and living upon the extremely small amount of juice that they can suck from ripening seeds. The life-history is shown in a new coloured plate, now in the press, and of which an advance proof is placed on the table [*exhibited*]. Like *Dysdercus*, it is not confined to cotton but is found on various other malvaceous plants, such as hollyhock, *Hibiscus* spp., *Abutilon* and *Thespesia*, but in all cases this insect seems only to be found in old, dried pods. In the case of cotton, eggs are laid on the seeds inside the lint, but this only occurs in the case of old, opened bolls, or bolls to which access can be obtained by means of some injury such as a hole of exit of *Earias*.

As regards control, no old open bolls should be left unplucked on the bushes ; this will prevent breeding to a large extent. When the bug is present in numbers, it may be collected in tr ys or tin funnels over which the affected bolls are shaken.

The chief damage done is not so much to the plant itself as by the crushing of the bugs (chiefly nymphs) when the cotton is ginned, so that the lint is stained.

Oxycarenus was very bad once at Cawnpur on stored seeds and unginned cotton. These were exposed to the sun and the bugs died. This happened, of course, in summer.

Alphitobius piceus has recently been reared from cotton seeds at Pusa. It is not a pest of the bolls on the plant, so far as we know, but apparently may attack the seeds kept for sowing and thus be of some small importance to the out-turn of the next crop.

We now come to the various sucking insects found on the cotton plant. Here again we have a long list but few are of any great importance :—

Aphis gossypii.
Empoasca sp.
Tetranychus telarius.
Eriophyes sp.
Machærota planitiæ.
Lygæus pandurus.
Serinetha augur.
Clavigralla horrens.
Eurybrachys tomentosa.

Pseudococcus (Dactylopius) virgatus.
" " *nipæ.*
Cerococcus hibisci.
Saissetia (Lecanium) nigra.
Chionaspis sp.

Aphis gossypii [" South Indian Insects," p. 499, fig. 388] is common on cotton in most districts but is rarely a serious pest, being kept in check by predaceous insects. It is fully described in " Indian Insect Pests " (pp. 110-111) and in Bulletin No. 10 (pp. 1-2), and I do not think there is much more to say about it. In the case of small experimental plots it can be checked by spraying if it appears in any numbers but this is hardly practicable on a field scale, when we must leave the natural enemies of this Aphid to keep it in check.

A species of *Empoasca* is common on cotton and seems to be especially prevalent and destructive in the Punjab. This species also is described in " Indian Insect Pests " (pp. 108-110) but we have not yet been able to get it named up definitely.

Will you tell us about it in the Punjab, Mr. Madan Mohan Lal ?

Mr. M. M. Lal. At Lyallpur *Empoasca* was once serious on American cotton. The leaves of this variety of cotton are not hairy, consequently the attack is serious on this variety. One plot was sprayed with Fish-oil Soap and it decidedly improved after spraying. Another point observed was that the weaker plants suffered more than the healthy ones. The leaves curl up as the result of attack.

Mr. Andrews. In the case of the attack of *Empoasca* on tea microscopical examination of the attacked leaves reveals that the leaf-cells are congested considerably as the result of the attack and this restricts the flow of the sap ; the leaves are consequently stunted.

Mr. Jhaveri. At Poona *Empoasca* has only been noticed on one occasion in any numbers on exotic cotton.

Mr. Andrews. As regards the sporadic way in which *Empoasca* may occur I can tell you of a case which happened with the *Empoasca* found on tea. A plot of 32 acres, right in the middle of a block of 5,000 acres of tea-bushes was seriously attacked by *Empoasca*. No one could tell where the insects had come from. The attack came on at the end of July and cleared up in August. Since then it has never reappeared.

Mr. Fletcher. Can you tell us anything about the life-history of this *Empoasca* on tea ?

Mr. Andrews. The eggs are very small, oval, and are laid on the surface of the leaves of tea.

Mr. Ramachandra Rao. In the case of *Empoasca* on cotton, the eggs are inserted in the tissue of the leaves.

There is evidently considerable diversity of habit in the different species and that affects control methods. Eggs laid on the surfaces of leaves could be got at by sprays, whereas those thrust into tissues would probably escape.

Tetranychus telarius is one of the "Red Spider" group of mites, but the exact identification of all these mites in India requires to be checked. The mite now under consideration is not uncommon on cotton at times but is hardly a serious pest.

A species of *Eriophyes* also occurs on cotton, especially in Southern and Western India.

It is sometimes serious on cotton leaves in Northern Gujarat and I tried a lime-sulphur wash to which soap was added, and the whole mixture diluted in the proportion of one in fifty of water. The sprayed plots looked much better after the treatment.

In Madras *Eriophyes* has been noticed on cotton leaves.

I am afraid that spraying is not practicable on a large scale.

Machærota planitiæ ["Indian Insect Life," p. 733, tab. 79] occurs commonly on cotton at Pusa and does some damage by stunting new growth of the plants. It does not seem to have been noted elsewhere.

Lygæus pandurus ["South Indian Insects," p. 481, fig. 365] occurs commonly on cotton, sometimes in considerable numbers, and may do damage at times, but it is not definitely known to be a pest.

Serinetha augur occurs commonly on cotton plants but is not known to be a pest. It has been stated by some observers that it sucks seeds in the same way as *Dysdercus*, but this has been denied by others and its exact feeding-habits seem to require further investigation.

Clavigralla horrens and *Eurybrachys tomentosa* are sometimes found on cotton in some numbers, but are scarcely pests.

Pseudococcus (Dactylopius) virgatus ["South Indian Insects," p. 510, fig. 398] occurs on the leaves and young shoots of cotton but is of little importance as a pest.

Pseudococcus (Dactylopius) nipæ ["South Indian Insects," pp. 509-510, fig. 397] also occurs on cotton in a similar way.

Cerococcus hibisci was originally described by Green [Agricultural Department, Entomological Memoirs, II. 19-21, t. 2 ff. 2-4] from examples on branches of *Hibiscus liliiflorum* from Bombay and on cotton at Pusa. It has since been figured and described in "South Indian Insects," p. 508, fig. 395. It is a conspicuous golden-yellow scale found on the twigs and stems of cotton and *Hibiscus* and the affected plants may easily be removed in case of a bad attack, although this scale is generally kept in check by parasites.

In Burma *Cerococcus hibisci* is rather bad on cotton on the Experimental Farms. I have never seen a serious attack of this insect in a single cultivator's field. I have used Crude Oil Emulsion with success as a spray against this pest. **Mr. Shroff**

Saissetia (*Lecanium*) *nigra* ["South Indian Insects," pp. 514-515, fig. 403] occurs fairly commonly on cotton, and individual plants or small patches of plants may be very badly attacked, the stems and branches of the plants being literally covered with the scales. The appearance of an attacked branch is shown in the figure in my book. The attack is usually very localized and can easily be checked by removal and destruction of the affected plants and any adjacent ones which are likely to be infected. **Mr. Fletcher.**

In Mysore this Scale attacks the cotton plant and was very bad on one occasion. **Mr. Kunhi Kannan.**

The last Scale on our list is an unidentified species of *Chionaspis* which is occasionally bad on cotton at Pusa, but we have no record of its occurrence elsewhere. **Mr. Fletcher.**

We now come to the insects found boring in the stem of cotton-plants :—

Sphenoptera gossypii.

Pempheres affinis.

Alcides affaber.

,, *leopardus.*

,, *fabricii.*

Zeuzera coffeæ.

Sphenoptera gossypii ["South Indian Insects," p. 298, tab. 8] is widely distributed in India but seems rather localized as a pest. In Madras it is only known in the Bellary District, in the Central Provinces it seems to be worst in Berar, and in Bombay it is a serious pest in the Surat district, but in the other parts of India, although it may occur, it does not seem to be much of a pest. The life-history has been described in "Indian Insect Pests," pp. 100-103, and there is not much to add. Control is best attained by prompt destruction of all attacked plants, which wither and are quite noticeable.

In Berar *Sphenoptera gossypii* was very serious about seven years ago, but the demonstration of uprooting and burning the affected plants has been very successful. The damage has now been reduced to a very great extent so that nowadays we find only about one plant attacked in a thousand. **Mr. Ratiram.**

In Surat this pest is very serious, but the removal of the affected plants has been found to be very successful. The pest is chiefly noticed in the young crop. **Mr. Jhaveri.**

Sphenoptera gossypii occurs in the Punjab also, but is a minor pest. It is found in Mysore also, near the Dharwar side.

Pempheres affinis. The life-history is described and figured in "South Indian Insects," p. 339, fig. 198, and the damage done to cotton is shown in figure 199. It is referred to under the name *Phylaitis* sp. in Bulletin No. 10, page 6. At Pusa it has been found in cotton, *bhindi* (*Hibiscus esculentus*), and there is also a record of it as found in *Cannabis* stem, but it seems doubtful whether this was really *Cannabis* or *Hibiscus cannabinus* in which it has been found at Coimbatore.

The distribution of this insect in India seems to be very little known. We know it from Pusa in Bihar and from Coimbatore and Cuddapah in Madras. Probably it is more widely distributed but has been overlooked.

As regards damage, this may be serious. At Coimbatore in 1912-13 a large proportion of the Cambodia cotton plants on the Farm was attacked and about twenty-five per cent. succumbed, being broken off by the wind. More recently, the attack has been much reduced but the cause of this reduction seems rather doubtful. It may perhaps be a case of selection, the seeds of the unattacked or less attacked plants surviving each year being used for the next year's crop; or it may be due to a reduction of the numbers of the insect in the area, owing to regular destruction of attacked plants—but on the other hand the areas under local cottons all around the Farm are full of this insect; or it may be merely a reduction in numbers due to natural causes.

As regards control, no really satisfactory method has yet been found. The badly attacked bushes, which break in the wind, should be removed regularly and destroyed. Painting of preventives, such as Crude Oil Emulsion, on the stems of young plants, is impracticable on a field scale. We tried the effect of Crude Oil Emulsion on the young plants at Coimbatore but the results were not very conclusive.

Some work on this weevil has been done at Coimbatore during the last two years. Will you tell us about it, Mr. Ramachandra Rao?

Pempheres affinis is a specific pest of cotton. It is chiefly found at Coimbatore. The egg is generally laid in the stem just below the epidermis. The grub bores into the stem and, due to the irritation caused, a swelling is formed. The young plants succumb to the attack and plants with these swellings often break down in high winds. Cambodia cotton is more liable to attack than other varieties.

A larger percentage of Cambodia plants break off as the result of attack. And as regards control?

As regards control, pulling out and burning the affected plants has been found very useful. **Mr. Ramachandra Rao.**

At Coimbatore *Pempheres affinis* is found in *Hibiscus cannabinus* also.

Alcides affaber has hitherto been mixed up with *A. leopardus* and the account of the latter in "South Indian Insects," pp. 338-339, fig. 197, refers wholly or in part to *affaber*. The habits of the two species seem very similar. **Mr Fletcher.**

Alcides affaber occurs at Coimbatore and bores in the shoots of cotton and *bhindi*. *A. leopardus* is not found in Coimbatore. **Mr. Ramakrishna Ayyar.**

Alcides leopardus has been reared at Pusa from larvæ boring the shoots and stems of cotton-plants. It is scarcely a pest. **Mr. Fletcher.**

Alcides fabricii is another weevil, with a black thorax and dark reddish-brown elytra with interrupted creamy stripes. We have a record of it from Nagpur "on cotton," but I do not know whether it was reared or whether it is merely another example of defective labelling.

Zeuzera coffeæ ["South Indian Insects," p. 446, fig. 323] very occasionally bores into cotton-plants but is not a pest of cotton in India. It has been noticed in cotton in Ceylon and Burma.

A few insects have been noted to damage cotton-plants by gnawing the bark. These are :—

Cœlosterna spinator.
Episomus lacerta

Cœlosterna spinator ["South Indian Insects," p. 325, fig. 180] has been recorded occasionally to eat the bark of cotton-plants but is not a regular pest of cotton.

Episomus lacerta ["South Indian Insects," pp. 327-328, fig. 181] also occasionally nibbles the bark of cotton-bushes, but is scarcely a pest.

The roots of the cotton-plant are attacked by :—

Termites.
Myllocerus 11-pustulatus.

Termites of various species will attack any cotton-plants that are injured or unhealthy but they are scarcely regular pests of healthy plants.

The larvæ of *Myllocerus 11-pustulatus*, whose life-history is shown in the coloured plate issued last year, live in the soil and feed on small roots of various kinds. The adults may therefore damage the leaves, and the larvæ the roots, of the cotton-plant and the insect is thus doubly a pest, although it is difficult to estimate how much damage is done below ground. The adult weevils can be collected and destroyed and this will reduce the damage by the next generation of larvæ.

That completes the insect pests of cotton, I think. Has anyone anything more to say about cotton-pests before we go on to *bhindi?*

In the Central Provinces, some experiments were tried at Telinkhedi Farm regarding the control of *Earias* on cotton by the use of *bhindi* as a trap-crop. Three plots were sown, one with cotton and *bhindi*, the second with cotton alone, the third with cotton and *bhindi*, each at a distance of one to two miles from the others. In the first plot the affected pods were destroyed and in the third plot this was not done. The loss percentage in plot No. 1 was about 5, whilst in Nos. 2 and 3 it was about 25.

There is no doubt that *bhindi* is useful as a trap-crop for *Earias*, provided that the affected pods and the trap-crop are properly destroyed at the right time. The difficulty in practice is to get this done. What happens is that the cultivator finds that he is getting an eatable or saleable vegetable from the *bhindi* plants and he will not destroy these plants. A control method of this sort may be all right on Government Farms or on limited areas under proper supervision, but I think we should be very chary of recommending trap-crops of this sort on a large scale without a great deal more investigation on the subject.

BHINDI (*Hibiscus esculentus*).

The insect pests of *bhindi* and of other species of *Hibiscus* are, generally speaking, very similar to those on cotton and in most cases they are identical, and it is as alternative food-plants for cotton-pests that these plants are chiefly of importance. So, as we have already discussed these insects under cotton, we need only run over them again very briefly.

Bhindi seedlings are attacked by—

Pachnephorus impressus.
Agrotis flammatra.

Pachnephorus impressus has been noted at Pusa and *Agrotis flammatra* is chiefly of importance in the Punjab.

Bhindi leaves are attacked by :—

Sylepta derogata.
Acontia intersepta.
,, *malvæ.*
,, *transversa.*
Cosmophila erosa.
Helcystogramma hibisci.
Atmetonychus peregrinus.

Myllocerus 11-pustulatus.
,, *viridanus.*
,, *blandus.*
Nisotra sp.
Mites.

Sylepta derogata occurs commonly on *bhindi* in all districts. The larvæ roll the leaves, as in the case of cotton, and may be handpicked.

Acontia intersepta has been reared on *bhindi* at Nagpur, but is not known as a pest.

Acontia malvæ has been reared on *bhindi* at Surat and *A. transversa* at Nagpur but they are scarcely pests.

Cosmophila erosa has been reared on *bhindi* at Pusa, Surat and Lyallpur but is rarely a pest.

Helcystogramma hibisci has been reared at Pusa on *bhindi* but is not a pest and seems to be attached to *Hibiscus rosa-sinensis* as a rule.

Atmetonychus peregrinus [*Fauna of India, Curculionidæ*, Vol. I, pp. 112-113, fig. 37] is known from Bengal, Bihar and the Punjab. It was found at Ambala on *bhindi* but is not known to do any damage to this plant.

Myllocerus 11-pustulatus occurs throughout India and is sometimes found on *bhindi* leaves in small numbers. *M. viridanus* was found on *bhindi* at Shoranore, in Malabar, and *M. blandus* at Pusa, but neither is known as a pest.

An unidentified Flea-beetle, probably a species of *Nisotra*, occurred at Moulmein in September 1914 in large numbers on *bhindi* and was doing considerable damage. In this case it was a serious pest, but we do not know any more about it.

Mites occur on *bhindi*, chiefly in Madras, as a minor pest.

Mr. Ramakrishna Ayyar. Mites attack *bhindi* leaves at Coimbatore and the affected leaves become discoloured.

Mr. Fletcher. The flowers of *bhindi* are eaten by Meloid and Cetoniad beetles. *Oxycetonia versicolor* has been noted in West Khandesh and *O. albopunctata* at Pusa. These beetles are easily controlled by collection by hand or in hand-nets.

The pods of *bhindi* are attacked by :—

Earias fabia.
,, *insulana.*
Heliothis obsoleta.

We have just now dealt with these two species of *Earias* under cotton and there seems no need to say any more about them now.

Heliothis obsoleta was found boring *bhindi* pods at Pusa in January 1916, but it must be regarded as a rarity on this plant and has never been noticed as a pest.

Various sucking insects occur on *bhindi* :—

Eurybrachys tomentosa.
Dysdercus cingulatus.
Oxycarenus lætus.
Corizus rubicundus.
Jassids.
Aphis malvæ.
Saissetia (Lecanium) nigra.
Pseudococcus (Dactylopius) nipæ.
" " *virgatus.*

Eurybrachys tomentosa has been noted on tender shoots of *bhindi* at Nagpur and Aurangabad but it is not a pest, I think.

Dysdercus cingulatus occurs on *bhindi* in large numbers and must be regarded as a pest.

Oxycarenus lætus occurs in old, dry pods in the same way as it does in cotton-bolls, but probably does little damage to the plant.

Corizus rubicundus is found in some numbers on *bhindi* and is probably a minor pest.

Jassids occur in all districts and are said to attack the *bhindi* crop in Bombay during the monsoon but we do not know the species concerned or much about the attack.

Jassids occur on *bhindi* leaves in Gujarat.

In the Central Provinces *bhindi* plants are attacked by Jassids at Nagpur.

Jassids occur on *bhindi* in the Punjab also.

Aphis malvæ has been found on *bhindi* at Pusa but scarcely as a pest.

Saissetia (Lecanium) nigra occurs more or less casually on *bhindi* but is also scarcely a pest.

Pseudococcus (Dactylopius) nipæ and *virgatus* occur in small numbers on the stems and shoots, but rarely give trouble as pests.

A few boring insects attack *bhindi* :—

Sphenoptera gossypii.
Alcides sp.
Pempheres affinis.
Robica honesta.

Sphenoptera gossypii occasionally bores into *bhindi* in the districts in which it occurs but is not a regular pest of *bhindi.*

Alcides sp. We have a record of *Alcides leopardus* as found on *bhindi*, but the Pusa Collection contains no examples reared from this plant and the record requires confirmation.

Pempheres affinis occurs in *bhindi* plants at Pusa and is probably more widely distributed, but overlooked. It does not, however, seem to do much damage in *bhindi*.

Robica honesta is a Lamiad beetle which has recently been bred at Mandalay from *bhindi*.

At Mandalay a couple of grubs of *Robica honesta* were found boring in the stems of *Hibiscus esculentus* and castor. **Mr. Shroff.**

At present, then, we can hardly call it a pest. Any more pests of *bhindi?* **Mr. Fletcher.**

Eelworms are getting quite serious in certain tracts of the Punjab, especially round about Lyallpur. Young as well as well-grown plants are injured. *Bhindi* and cotton are liable to their attacks. **Mr. M. M. Lal.**

ROZELLE (*Hibiscus Sabdariffa*).

The pests of Rozelle are very similar to those of *bhindi* on the whole, but there are one or two differences so far as we know at present. **Mr. Fletcher.**

The top-shoots are attacked by *Phycita infusella*, so that this *Hibiscus* is an alternative food-plant for this cotton-pest.

The leaves are eaten by larvæ of *Cosmophila erosa* and *Sylepta derogata*.

As regards the pods, it is worthy of note that up to date we have not bred either *Earias* or *Gelechia* from Rozelle.

AMBADI (*Hibiscus cannabinus*).

[*Gogu*—Madras.]

Here again the pests are very similar to those on cotton and *bhindi* and need not detain us long.

The flowers are attacked by *Zonabris pustulata* in Madras and probably by allied species in other districts.

The leaves are eaten by :—

Euproctis scintillans.
Diacrisia obliqua.
Telchinia violæ.
Phycita infusella (top-shoots).
Cosmophila erosa.
Nisotra madurensis.
Dereodus mastos.
Myllocerus 11-pustulatus.
,, *discolor.*

Euproctis scintillans ["South Indian Insects," p. 399, fig. 268] is occasionally serious on *gogu* in Madras, but is usually a minor pest of little importance.

Diacrisia obliqua may occur on this plant in districts where this insect occurs as a general pest of low-growing plants, but *ambadi* is not grown very much in the districts chiefly troubled with *Diacrisia*.

Telchinia violæ has been found in Bihar as an occasional minor pest, but is of no real importance. It feeds also on a wild Passion-flower (*Modeca palmata*).

Phycita infusella is found in the top-shoots but is scarcely a pest.

Cosmophila erosa may occur on the leaves as a very occasional pest, usually minor.

Nisotra madurensis ["South Indian Insects," pp. 310-311, fig. 160] has been noted as a minor pest in Madras.

Dereodus mastos [*Fauna of India, Curculionidæ*, Vol. I, pp. 124-125, fig. 41] has been found on *gogu* at Coimbatore but is not a pest so far as we know.

Myllocerus 11-pustulatus has been found on *ambadi* at Pusa and Poona and probably occurs in all districts as a minor pest.

Myllocerus discolor has been found on *gogu* at Coimbatore but is probably not a real pest.

Sucking insects found on *Hibiscus cannabinus* include :—

Dysdercus cingulatus
Oxycarenus latus.

Both of these occur in much the same way as on *bhindi* and need not be mentioned further.

In the Central Provinces both these bugs occur on the pods in very large numbers.

Boring insects in the stem of *Hibiscus cannabinus* include :—

Alcides leopardus
„ *affaber*
Pempheres affinis.

Alcides leopardus seems to occur chiefly in Northern India, all our specimens being from Bihar. The larva bores in the shoots and stems and may be a minor pest, but we seem to know very little about it.

Alcides affaber occurs in *gogu* stems at Coimbatore in December-February as a pest. Probably it occurs throughout Madras but we do not know its exact distribution.

Pempheres affinis also breeds in stems of *Hibiscus cannabinus* and this plant serves as an alternative foodplant. It is not of any great importance as a pest in this plant.

Mr. M. M. Lal. In the Punjab *Earias insulana* attacks the fruit-capsules of this plant, which is grown to some extent round about the sugarcane plots.

Mr. Fletcher. We have never found *Earias insulana* in *ambadi* at Pusa.

Mr. Khare. It has not been noticed in the Central Provinces.

Hibiscus abelmoschus.

Mr. Fletcher. This is another plant without any regular English name. In Hindustani it is called *mushkdana* and *Kastari bhindi.* It is not grown as a regular crop but we have been growing it in connection with our work on cotton bollworms, as it is a very favourite foodplant for *Earias.*

The leaves are sometimes attacked by *Diacrisia obliqua* larvæ.

The shoots and pods are attacked by :—

Earias fabia
„ *insulana*
„ *cupreoviridis* (*chromataria*)
Gelechia gossypiella
Prodenia litura
Dysdercus cingulatus
Oxycarenus lætus.

As regards the species of *Earias*, our experience is that *H. abelmoschus* is attacked much more freely than cotton. As regards the species concerned, we get roughly 3 *insulana* and 2 *cupreoviridis* to every 100 examples of *fabia*. It is noteworthy that *cupreoviridis*, which is otherwise known to feed on *Sida* and jute, has only been reared so far from *H. abelmoschus* and not from the other species of *Hibiscus* or from cotton.

Gelechia gossypiella is found to a very small extent in the flowers and seeds inside the pods of *H. abelmoschus*, so that this plant is less attractive than cotton to *Gelechia*.

Prodenia litura has been reared once only at Pusa from a pod, and is evidently a mere casual visitor in this plant.

Dysdercus cingulatus and *Oxycarenus lætus* both occur on *H. abelmoschus* as on other species of *Hibiscus*.

The points about *H. abelmoschus*, then, are :—

(1) that it is extremely attractive to *Earias fabia* and (at Pusa to a less extent, probably because it is the less common species occurring here) to *E. insulana*. It is therefore more likely to be of use as a trap-crop and, as it does not provide a vegetable like *bhindi*, it is more likely to be destroyed at the right time,

(2) it is the only *Hibiscus*, so far as we know, which is a foodplant of *Earias cupreoviridis*.

(3) it is not specially attractive to *Gelechia gossypiella*.

As regards our experience in using it as a foodplant for rearing *Earias* and its *Rhogas* parasites,

(4) the *Earias* larvæ first of all attack the shoots of *H. abelmoschus*, before flowers or seed-capsules are present, and can therefore be reared early in the season,

(5) these *Earias* larvæ in the shoots are parasitized by *Rhogas* to a much greater extent than they are in cotton-bolls.

In the Punjab *Hibiscus abelmoschus* is found very useful to breed bollworms during February and March, when cotton is not available in the parasite-breeding plots.

Hibiscus rosa-sinensis.

Hibiscus rosa-sinensis is a common garden plant, grown all over India, and is chiefly of importance to us as possibly affording an alternative foodplant to some cotton-pests. You may also be called on to treat it for other pests as an ornamental garden-plant.

The flowers are often seriously eaten by Meloid beetles, of which there are numerous species not clearly differentiated as yet. At Pusa we get *Zonabris phalerata* commonly about November and *Z. pustulata* occurs at Coimbatore. These beetles are easily caught by hand or in handnets.

A few beetles, mostly weevils, also eat the leaves.

Hypomeces squamosus occurred on the leaves at Myitkyina, in Upper Burma, in September 1914. It seems to be common in Burma but we have no specimens from India.

Desmidophorus hebes has occurred in large numbers in Darbhanga on at least two occasions, once in or previous to 1888 (as recorded in *Indian Museum Notes*, Vol. I. No. 1, p. 58) and again in July 1906. On one of these occasions this weevil occurred on *Hibiscus* but there seems to be no record of the species of *Hibiscus* concerned; it may have been *H. rosa-sinensis*.

Dysdercus cingulatus occurs on *H. rosa-sinensis* but is not very common as a rule.

Aphids also sometimes occur in small numbers.

At Sabour Aphids are very bad on this plant in the early spring.

Abutilon indicum.

Abutilon indicum is a common weed found in most parts of India. It is of some importance to us as affording an alternative foodplant for cotton-pests.

The leaves are attacked by :—

Diacrisia obliqua.
Cosmophila fulvida.
Tarache opalinoides.
Acontia malvæ.

Diacrisia obliqua will feed on this, as on practically all low-growing plants.

Cosmophila fulvida occurs throughout India, Burma and Ceylon. At Pusa it has been reared on *Abutilon indicum* and on *Sida* sp. It has not yet been noted on any cultivated plant but may be found on cotton, *Hibiscus*, hollyhock, etc.

Tarache opalinoides ["South Indian Insects," p. 382, fig. 244] is occasionally found on *Abutilon* and we have already noticed it under cotton.

Acontia malvæ has been reared at Nagpur on *Abutilon* and we have already noticed it under *bhindi.*

The capsules of *Abutilon indicum* provide food for :—

Earias fabia.
,, *insulana.*
Gelechia gossypiella.
Oxycarenus lætus.
Dysdercus cingulatus.

Earias fabia and *insulana* have been reared at Pusa on *Abutilon* and this plant is of some importance, especially in the Punjab, in carrying on these species during the period that cotton is not in the ground. The removal of this weed is therefore indicated.

Gelechia gossypiella has only been bred once at Pusa from *Abutilon*, so this is evidently not a favourite foodplant of *Gelechia*, but still it can breed in it and probably does so on occasion.

Dysdercus cingulatus and *Oxycarenus lætus* both occur commonly on *Abutilon* and we need not discuss them again.

Mr. Ratiram. Throughout the Central Provinces a small weevil is found attacking the fruits of *Abutilon indicum*. This weevil does not occur on any cultivated variety of *Hibiscus*.

Mr. Fletcher. We should like to see some specimens of that.

Malva parviflora.

[*Sonchal*—Punjab.]

Malva parviflora is a common weed in the Punjab and also provides an alternative foodplant for *Earias insulana*.

HOLLYHOCK (*Althæa rosea*).

Hollyhock is a common garden plant and we have also been using it in our bollworm parasite-breeding plots. It is also being used in the *Rhogas* breeding-plots.

The leaves are attacked by :—

Sylepta derogata.
Spialia galba.
Acontia sp.

Sylepta derogata rolls the leaves much as in the case of cotton and *bhindi.*

Spialia galba (*Hesperiadæ*) is widely distributed throughout the Plains of India and at Pusa has been reared from larvæ on hollyhock leaves, and also on *Sida rhombifolia* and soy-bean. It is not a pest.

We have also a record of an *Acontia* larva found on the leaves, but it was either not reared or not named.

The flowers and pods provide food for *Earias insulana* and *E. fabia*, which will breed in hollyhock but it is not a very favourite foodplant.

Gelechia gossypiella has also been recorded as "on hollyhock" at Pusa but here again we have a case of defective labelling. Probably it does occur in hollyhock as it has been reared from this plant in Egypt.

The sucking insects found on hollyhock include :—

Dysdercus cingulatus.
Oxycarenus lætus.
Corizus rubicundus.
Nezara viridula.

Dysdercus cingulatus is decidedly fond of hollyhock and almost every garden-plant usually has some of these bugs on it.

Oxycarenus lætus occurs on the dry pods.

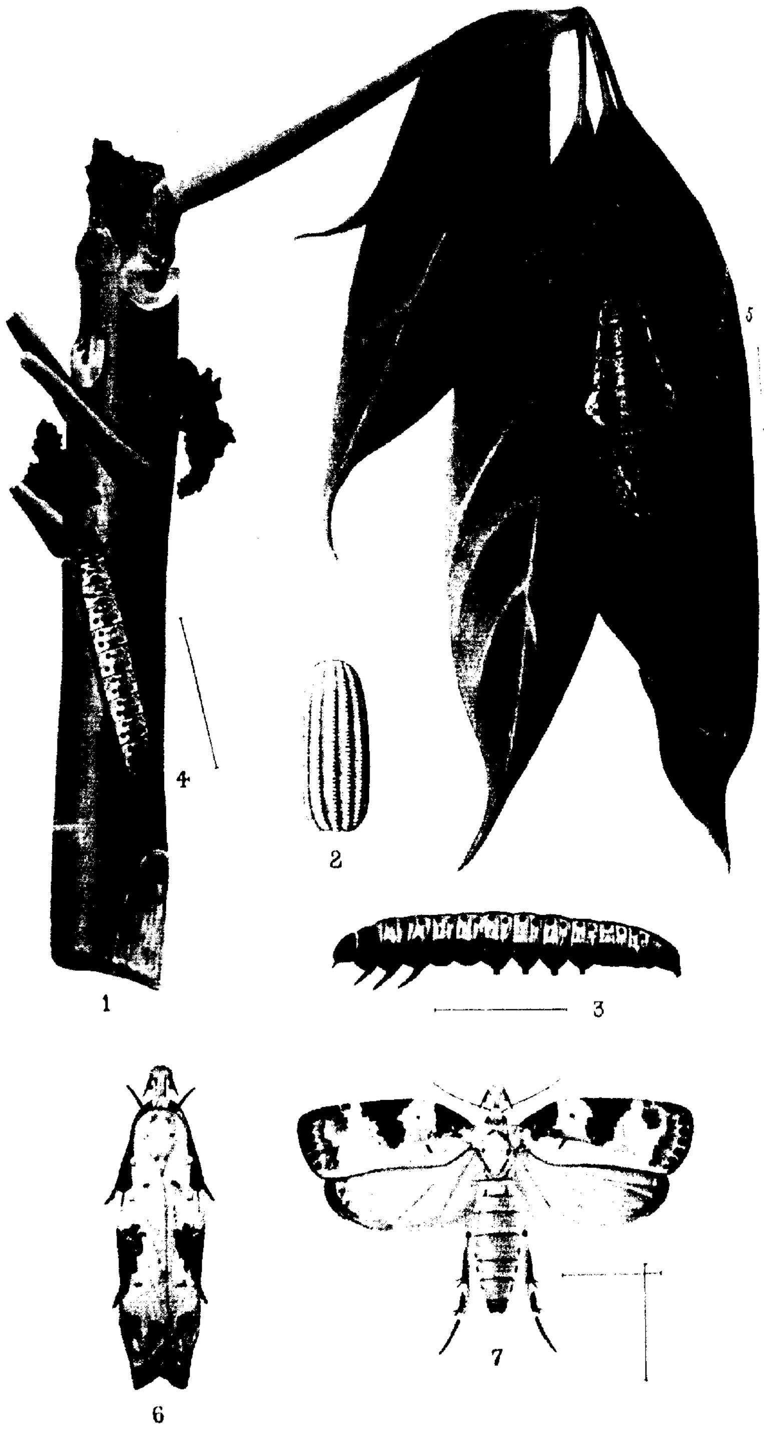
Corizus rubicundus is common on garden plants, often in numbers, and is a minor pest.

Nezara viridula also sometimes occurs in some numbers on the flower-stems.

SILK COTTON (*Bombax malabaricum*).

[*Simal*—Hind.]

Silk-cotton belongs to the Malvaceæ but differs from the other plants of this Order by having rather a peculiar insect-fauna. We find a good many insects which seem confined to *Bombax* and do not occur on cotton, *Hibiscus*, etc.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Tonica (Binsitta) niviferana, Wlk.

Fig. 1, the top of a young tree showing damage.
Fig. 2, egg.
Figs. 3 and 4, larva.
Fig. 5, pupa.
Figs. 6 and 7, moth.
All figures are enlarged. The hair-lines show the natural sizes.

The seedlings are occasionally attacked by *Desmidophorus hebes.* We have a record of this at Jalpaiguri, in May 1904, when these weevils were found attacking seedlings in the forest plantation as well as in the forest nursery.

On the leaves we get :—

Tenaphalera elongata.
Apogonia ferruginea.

Tenaphalera elongata, Crawf., is a curious green Psyllid which occurs at Pusa on the undersurface of the leaves, generally at the beginning of December. The attack may be very severe, but is of less importance as the leaves fall off the trees in another couple of months' time.

Apogonia ferruginea attacks the new leaves at Pusa in May and June and these leaves are frequently found riddled and skeletonized, due to the attack of this Chafer. The beetles fly at dusk and may then be seen in swarms flying around and feeding on the leaves.

The flowers and pods of *Bombax* are attacked by the larvæ of *Mudaria cornifrons*, which occurs at Pusa in large numbers in the pods when these ripen in April. The larvæ feed on the seeds and spoil the lint; when full-fed they emerge from the pods and burrow in the ground, the resulting moths emerging in March of the next year.

The shoots (and stems in the case of young plants) are bored by the larvæ of *Tonica niviferana*, whose lifehistory is shown in a coloured plate [*exhibited*] now in the press. It is not a serious pest, but the young growth is stunted. It occurs at Pusa and Nagpur and is probably widely distributed, but is not a bad pest.

Boring in the trunk we find several longicorn beetles :—

Batocera rubus.
Acanthophorus serraticornis.
Plocœderus obesus.
Glenea spilota.

Batocera rubus has been bred at Pusa from a larva in a *Bombax* stem, but we seem to know very little of its occurrence in this tree.

Acanthophorus serraticornis ["South Indian Insects," pp. 319-320, fig. 173] was found at Bangalore on *Bombax*, but it is not certain whether it was breeding in this tree.

Plocœderus obesus is recorded as from *Bombax malabaricum* in the United Provinces [Stebbing, "Forest Coleoptera," pp. 295-300, figs. 205-206] but we have no further knowledge of it.

Glenea spilota is also recorded from *simul* in "Indian Insect Life" but probably only occurs in decaying stems. [see Stebbing, "Forest Coleoptera," p. 379].

The seeds of *Bombax* are extremely attractive to *Dysdercus cingulatus* and masses of these bugs occur on and around *simul* trees when these are in seed. They can then be killed in numbers before they disperse and attack cotton, *Hibiscus*, etc.

We will next take the

NON-MALVACEOUS FIBRE-PLANTS.

under which heading we include Jute, Aloe and *Calotropis*.

JUTE (*Corchorus capsularis*).

Jute seedlings are attacked by :—

Laphygma exigua.
Brachytrypes portentosus (*achatinus*).

Laphygma exigua is sometimes a serious pest, occuring regularly in most years and sometimes doing great damage by checking the growth of the plants.

Brachytrypes portentosus also attacks the seedlings but is usually a minor pest, sometimes doing considerable damage, chiefly in Bengal in May and June. We have already dealt with both these insects before and there seems to be nothing particular to add about them here.

Jute leaves and topshoots are attacked by :—

Diacrisia obliqua.
Cosmophila sabulifera.
Prodenia litura.
Creatonotus gangis.
Tarache crocata.
Perigea capensis.
Nisotra madurensis.
Trachys sp.
Tanymecus indicus.
Myllocerus viridanus.
,, *discolor.*

Diacrisia obliqua is a serious pest on the leaves of jute in Bengal and Bihar, attacking the plant when it is about three or four feet high. In later stages of growth, the attack is less serious. If care is taken to take the attack in time and to handpick the eggmasses and bunches of young larvæ, whilst these are still gregarious, this method of control is quite effective.

Handpicking has been found useful in Bengal but the cultivators do it only under official pressure.

At Sabour Farm *Diacrisia* is very bad and handpicking is done. **Mr. H. L. Dutt.**

Diacrisia occurs in Assam also. **Mr. Gupta.**

Cosmophila sabulifera [" South Indian Insects," pp. 390-391, fig. 256] occurs in all jute-growing districts as a major pest of jute. It is known from South Arcot, Godavari, Samalkota, Dharwar, Belgaum, Poona, Nadiad, Nagpur, Pusa, Dacca and throughout Bengal and Bihar. **Mr. Fletcher.**

If the plants are sufficiently young and water is standing in the field, control may be effected by running a film of kerosine over the water and disturbing the plants, when the larvæ drop.

Cosmophila sabulifera is the worst of all the pests of jute because it checks the growth of the plant and causes sideshoots to grow, thereby damaging the length of the fibre. The only thing possible to do against it is to disturb them as much as possible by stirring the plants, when the caterpillars jump off. The work of killing them is facilitated by pouring a little kerosine on the water if it happens to be standing in the field. **Mr. Ghosh.**

In Bengal dragging a kerosinized rope over the affected crop has been found useful. Bagging is not possible because the pest appears at a time when the crop is fairly high, three to four feet in height. **Mr. P. C. Sen.**

Such has been our experience in Bihar also. **Mr. H. L. Dutt.**

In Assam also *Cosmophila sabulifera* is a serious pest of jute, and the rope treatment is carried out on plants up to four to five feet high. **Mr. Gupta.**

With regard to the driving away of caterpillars from infested areas, I once tried the following method: I took a wire and twisted it into a spiral, which was twisted into a bigger spiral, and this was dipped into melted sulphur to which saltpetre was added. This spiral was ignited and taken through the affected field and the fumes drove away the caterpillars. This method was tried in a field comprising 50 acres. **Mr. Andrews.**

I am afraid that it would not be practicable in the case of jute fields as these fields are generally adjacent to villages. **Mr. Fletcher.**

Prodenia litura has been found on jute at Pusa and is sometimes quite a bad pest.

Prodenia litura comes second to *Diacrisia* as a pest of jute, and occasionally does serious damage. It occurs when the plants are three to four feet high, and is amenable to the same methods of control as *Diacrisia*. **Mr. Ghosh.**

Creatonotus gangis is occasionally found on jute but is scarcely a pest. **Mr. Fletcher.**

Tarache crocata is widely distributed throughout the Plains of India, Burma and Ceylon. The larva is sometimes found on jute but it is scarcely a pest.

Tarache crocata was found in one year in large numbers on jute at Nagpur, but jute is not grown as a field-crop at Nagpur.

Perigea capensis has been found on jute at Pusa but is not known as a pest of this crop.

Nisotra madurensis [" South Indian Insects," pp. 310-311, fig. 160] has been recorded on jute in Madras, the beetles eating the leaves. But it is not a serious pest, and does not seem to be known outside of Madras.

Trachys sp. This is a small Buprestid beetle which seems to be confined to Bengal and Bihar. At Pusa it is not common, but in Bengal it has been noted as a pest, and we have records of it from Purnea, Rangpur, and from near Dacca. In the last case the plants left for seed were riddled with holes, the larva mining the leaves.

In Bengal *Trachys* is only a minor pest on Jute.

So it is in Bihar also.

Trachys has not been noticed at Pusa for the last three or four years. It used to occur in small numbers. The larva mines the leaf, pupating inside the mine.

Tanymecus indicus and *Myllocerus discolor* have been found on jute leaves at Pusa and *M. viridanus* at Kumbakonam, but none of these are regular pests.

Boring in the stem of jute we find an unidentified *Apion*, referred to as the " Jute Apion " in " South Indian Insects," p. 331, fig. 188. In Madras it is known from Bellary and Godavari and it is also known in Bengal and Bihar.

The grub is usually found just at the junction of the leaf-petiole with the stem and it bores sufficiently to cause a break of a good many fibres at that place. Its presence can usually be detected by the withered and drooping leaf. At Pusa it occurs every year in small numbers, attacking the plants in all stages of growth. It sometimes occurs in the top-shoots as well.

This *Apion* is a minor pest in Bengal.

A serious attack was reported from Chinsura five or six years ago. It is not common as a rule.

No control seems called for as a rule and indeed the damage is only seen after it has been done.

Sucking insects on jute include :—

Mites.

Graptostethus servus.

Mites sometimes occur on jute-leaves but are not important as a rule in the wetter districts in which jute is grown.

At Lyallpur, in the experimental plot of jute, mites were noticed last year for the first time.

An attack of mites was reported one year from Purnea. **Mr. Ghosh.**

Graptostethus servus has been noted on jute capsules but is not a pest. **Mr. Fletcher.**
The capsules of jute are also bored by *Earias cupreoviridis* (*chromataria*), which occurs fairly commonly on jute in Bengal and Bihar but is scarcely a pest.

ALOE (*Agave americana*).

Aloe is fairly free from pests but in Madras one often sees leaves bored with large holes, evidently the result of attack whilst the young leaves were still unexpanded, and this is generally supposed to be the result of attack by the adult of *Oryctes rhinoceros*, although I do not think that this insect has ever been caught in the act. When aloe plants have flowered, the central flower-spike often falls down, or is removed, leaving a sort of hollow basin which catches rain-water. This collection of rain-water is a common breeding-place for mosquitos and incidentally I may mention that the aloe leaves themselves often hold rain-water and thus serve as breeding-places for mosquitos. By the effect of the rain-water, the central part of the plant rots away, and this mass of rotting vegetable matter is rather a favourite breeding-place for *Oryctes rhinoceros* grubs. I just mention this now, whilst we are dealing with aloe; we shall come to *Oryctes* later on, under Palms, but this is the sort of place in which *Oryctes* grubs may be breeding in numbers and which is very easily overlooked.

CALOTROPIS (*Calotropis* spp.)

[*Akh*, *Madar*—Hind.]

Calotropis is rather a good instance of the difficulty in defining the limitations within which lies the subject of the control of insect pests, primarily of crops. *Calotropis* is not cultivated as a crop in any part of India so far as I know although it has been suggested as a fibre crop. In Southern India we get *Calotropis gigantea* and in the drier tracts of Northern India this is replaced by *C. procera* but both are very similar. Both species grow wild, in waste lands and on field embankments, and in most districts they are looked on as weeds. In some localities, however, they are put to considerable use. At Coimbatore, for example, the plants are carefully collected and are used as green manure in the preparation of rice-fields and the plants are so esteemed for this purpose that a cartload of *Calotropis* plants will fetch as much as Rs. 3. In Rajputana the plants are used for fibre, prepared from the stems, and in Bengal and in most districts the floss of the seedheads is greatly

esteemed for stuffing pillows. So that insects which attack *Calotropis*, weed though it may be, may fairly be included in our list of crop-pests.

The leaves of *Calotropis* are eaten by :—

Paramecops farinosa.
Dereodus pollinosus.
Danais chrysippus.
Pœcilocerus pictus.

Paramecops farinosa ["South Indian Insects," p. 333, fig. 190] occurs in most parts of India. The beetles eat unsightly patches in the leaves and may eat away a good deal of the leaf tissue. They are easily collected by hand.

Dereodus pollinosus [*Fauna of India, Curculionidæ*, Vol. I, p. 121] occurs chiefly in the Hill Districts of North-Western India and has been found on apple at Kulu. We have a record of it on *Calotropis* at Amritsar but there seems to be no information as to any damage done to *Calotropis*.

Danais chrysippus in the caterpillar state is commonly found on *Calotropis* leaves, as most of you know who have occasion to lecture on Entomology, as it is commonly used in our Agricultural Colleges as a typical example of the metamorphosis of a butterfly.

Pœcilocerus pictus is the large blue and yellow grasshopper commonly found on *Calotropis* in most parts of India. It is described in "South Indian Insects," pp. 526-527, fig. 419, and we have since shown its lifehistory on a new coloured plate [*exhibited*] now in the press. This grasshopper does not occur at Pusa and our material for the lifehistory was derived from the descendants of half-a-dozen living examples sent from Rajputana. The grasshoppers are easily caught when abundant on the plants.

Several sucking insects occur on *Calotropis* :—

Eurybrachys tomentosa.
,, *ferruginea.*
Homalocephala festiva.
Lygæus pandurus.
Aphids.

None of these are of any great importance.

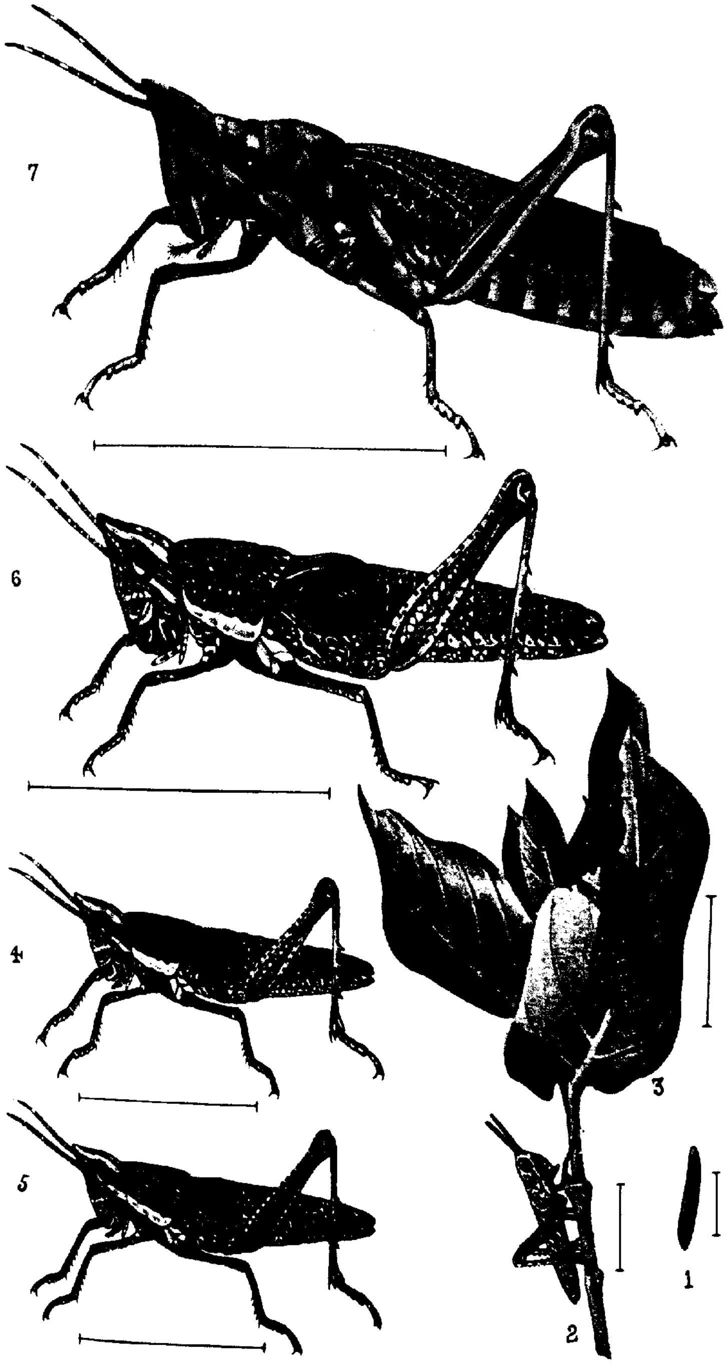
Eurybrachys tomentosa is common on the shoots of *Calotropis gigantea* in Madras and breeds on this plant.

Eurybrachys ferruginea also occurs on *Calotropis* in Madras, but is not very common.

Homalocephala festiva occurs in small numbers on *Calotropis* at Coimbatore. It is not a pest but I quote it as an example of those insects, really rather common, which are looked on as rarities until

Pœcilocerus pictus, Fb.

Fig. 1, a single egg detached from the cluster.
Figs. 2 to 6, the nymph in different stages of growth (note the developing wing-pads).
Fig. 7, the adult grass hopper.
The hair-lines indicate natural sizes.



PŒCILOCERUS PICTUS.

their habits are known. This Fulgorid is described and figured by Distant [*Fauna of India, Rhynchota*, Vol. III, p. 199, fig. 86] apparently from a single specimen from "Madras" in his own collection. A short search on *Calotropis* plants at Coimbatore about November or December shows that it is really not uncommon.

Lygæus pandurus ["South Indian Insects," p. 481, fig. 365] is found commonly on *Calotropis* throughout India.

A yellow Aphid often occurs in masses on young shoots and probably checks the growth of the plants.

The fruits of *Calotropis* are attacked by :—

Dacus longistylus.

Paramecops farinosa.

Dacus longistylus is an African Fruitfly, described by Wiedemann eighty years ago, but only definitely recorded from India within the last three years. It is known from Coimbatore, Orissa, and Nagpur and is doubtless common on *Calotropis* throughout India. The larvæ live in the fruits and damage the floss.

Paramecops farinosa as an adult eats the leaves, but the larvæ live in the fruits and bore about, damaging the floss.

The grubs of *Paramecops farinosa* bore into the fruits, damaging the lint. In Bengal the lint has a value, being used for the same purposes for which Silk-cotton lint is used. It is softer than Silk-cotton lint. The plants are gathered and used for fuel. **Mr. Ghosh.**

We will go on to Sugarcane, Paddy and other Cereals, Grasses and Fodder Crops. **Mr. Fletcher.**

SUGARCANE (*Saccharum officinarum*).

Sugarcane setts, that is, the pieces of cane used for planting, are attacked in almost all districts by Termites. The species of Termites concerned probably vary a good deal with locality and that is a subject we require to know more about. At Pusa we get chiefly *Microtermes obesi* and that seems to be a common pest of cane-setts in most parts of India. We have been trying various experiments at Pusa with a view to protection of cane setts from the attacks of Termites and, as these have been carried out in the Insectary here, Mr. Ghosh will give us an account of them.

The following insecticides were tried to protect sugarcane setts against termites :— **Mr. Ghosh.**

Resin Compound—setts dipped in stock solution.

Naphthaline Emulsion—setts dipped.

Lead Arsenate—setts dipped in solution.

Crude Oil Emulsion :—
- (*a*) smearing setts.
- (*b*) dipping setts in solution.
- (*c*) earth mixed with Crude Oil Emulsion spread in furrows in which setts planted.

Fish Oil Resin :—
- (*a*) smearing setts.
- (*b*) dipping setts in solution.

Creosote :—
- (*a*) setts dipped in creosote.
- (*b*) ends of setts dipped in creosote.
- (*c*) creosoted earth in furrows in which setts planted.

Sanitary Fluid—setts dipped in solution.

Copper Sulphate :—
- (*a*) dipped in saturated solution.
- (*b*) powder mixed with earth.

Clifts Powder—mixed with earth.

Apterite.

Formalin—setts dipped in solution, strength 1 per cent. to 5 per cent.

Of all these, Lead Arsenate has up till now been found to be the best. The setts are dipped in solution (1 lb. Lead Arsenate in 2 gallons cold water) and dried in shade and then planted.

Our experience is that it is not so much setts as the new shoots which require protection. Frequently the untreated setts sprout as well as the treated ones and the termites do the real damage to the new shoots. It has been observed that treatment with Lead Arsenate affords some protection to the new shoots. Further experiments will be undertaken on this line, that is to say, the subsequent use of measures to protect the newly-sprouted shoots.

In the Punjab, at Gurdaspur comparative trials were made with Lead Arsenate, Crude Oil Emulsion, and Copper Sulphate. Lead Arsenate and Crude Oil Emulsion gave good results, but Crude Oil Emulsion had to be continued for a month, being applied in the irrigation water.

At Coimbatore some experiments were started two years ago, but unfortunately they were not carried to a finish. The following insecticides were tried :—

(1) Dipping the setts in Crude Oil Emulsion.

(2) Dipping the setts in Fish Oil Soap.

(3) Dipping the setts in dilute solution of Mercury Perchloride (1 in 2,000).

(4) Protecting the ends of setts with balls of Naphthaline.
(5) Dipping the setts in Lead Arsenate solution.
(6) Dipping the setts in Tobacco Decoction.
(7) Putting Carbon Bisulphide in holes in the soil $1\frac{1}{2}$ feet apart.
(8) Introducing Potassium Sulpho-Carbonate in the irrigation water.
(9) Pouring Potassium Xanthogenate in the irrigation water.
(10) Oil-cakes, such as Nim-cakes, used for manure.
(11) Dipping the setts in Bordeaux mixture.
(12) Tarring the ends of the setts.
(13) Dipping the setts in " Mortant " solution.

These were tried in small plots, each 1/100 acre.

Of these experiments, No. (8) gave the best results.

Mr. Fletcher. Can you tell us the cost of this Potassium Sulpho-carbonate treatment ? It is scarcely practicable at present, as Potassium Salts are practically unobtainable.

Mr. Ramachand Rao. It was very cheap before the War, but is not obtainable now.

Mr. Fletcher. How does it act ?

Mr. Ramachand Rao. Potassium Sulpho-Carbonate is decomposed into Carbon Bisulphide and Sulphuretted Hydrogen, the latter serving as a manure. Potassium Xanthogenate was found to be a good substitute for Potassium Sulpho-Carbonate, when the latter was unobtainable. It was prepared in the Chemical Laboratory at Coimbatore. The mixture was simply poured into the water running through the furrows.

Mr. Fletcher. Was one application sufficient or had it to be repeated ?

Mr. Ramachand Rao. Whether we use Potassium Xanthogenate or Potassium Sulpho-Carbonate, it has to be repeated two or three times at intervals of a fortnight.

Mr. Fletcher. Potassium Xanthogenate has been tried outside of India as a soil-insecticide and there was some account of it in the " Review of Applied Entomology." I read the account at the time but the high cost of treatment and the limited depth in the soil at which it is effective seem to put it outside the range of practical politics for use on a field-scale in India.

The best method of control of the attack of Termites on sugarcane setts in India still remains to be worked out. Where irrigation is available and is given to the germinating cane, the use of a deterrent, such as Crude Oil Emulsion, in the water channel seems to be best method at present. Further work will be done with Lead Arsenate but I am doubtful whether the use of a poison of this sort, even if it is successful, can be recommended in a country such as India.

The young shoots of sugarcane are attacked by numerous insect pests :—

Gryllotalpa africana.
Pachnephorus impressus.
Pachnephorus bretinghami.
Myllocerus 11-pustulatus.
Myllocerus blandus.
Myllocerus discolor.
Papua depresella.

Gryllotalpa africana ["South Indian Insects," pp. 534-535, fig. 138], the common Indian mole-cricket, is common in cane-fields and, when abundant, may do damage by eating the young shoots.

In 1912 mole-crickets were observed to damage sugarcane shoots at Pusa in February and March; this cane had been planted in the preceding November. The external symptom of damage was a "dead-heart," usually characteristic of damage by borers. The mole-crickets had their burrows deep in the ground, and they came up and gnawed a hole at the base of the shoot near its junction with the sett, until they reached the soft base of the heart, which was eaten. Considerable damage was done and, as the crickets were about $1\frac{1}{2}$ to 2 feet deep in the soil and could not be got at easily, it was hardly possible to do anything to check the damage.

In such cases of damage, where it is possible, irrigation will flood the crickets out of their burrows, when they are usually attacked by birds. But in Bihar cane is not usually grown as an irrigated crop.

Pachnephorus impressus was common in May 1916 at Peshawar on young cane shoots, the adult beetles riddling the leaves with holes and doing appreciable damage. The beetles can be collected by hand but are not very easily caught, as they drop off the plants and either fall to the ground or inside the tube formed by the growing leaves.

Pachnephorus bretinghami is stated by Lefroy ["Indian Insect Life," p. 359] to have the same habit, but we do not seem to have any other exact record of this species on cane. Probably both species occur throughout India.

The adult beetles of *Pachnephorus* have been observed at Pusa to damage the tender leaves of the young sugarcane shoots. They were found in numbers and could be collected easily in a pan of kerosinized water by shaking the shoots over it.

In the Punjab the adult beetles of *Pachnephorus* are observed on the leaves of young cane-shoots, riddling the leaves with holes but they do not do any appreciable damage to the crop.

Myllocerus 11-pustulatus, M. blandus and *M. discolor* are all found on young cane-leaves as adult weevils and, when in numbers, may do damage, but they are not regular pests. **Mr. Fletcher.**

Papua depressella (*Polyocha saccharella*) was found at Pusa, last year for the first time, boring into young shoots of cane from newly-planted setts. This species occurs at Pusa commonly every year and has been under observation for the last ten or twelve years, but hitherto we have only known it as a borer in the roots of cane. If the roots are examined when the old cane is removed from the field, they are generally found to contain large numbers of the caterpillars of *Papua depressella*. Although cane-borers, that is, borers in the shoots and stems of cane, have been reared at Pusa in large numbers for many years past, we had not hitherto found *Papua depressella* amongst these. Last year the new shoots were extensively bored by this insect, roughly fifty per cent. of the new shoots being affected. The sudden change of habit seems most interesting. We have figured the stages of the lifehistory of this species on a new coloured plate [*exhibited*] and this shows the attacked stem with a "dead-heart" usually characteristic of borer attack.

Papua depressella was hitherto known as a root-borer and used to be found commonly in the roots of the ratoon crop. But in 1916 it affected the young shoots, practically producing the same effect as the other borers do; the damage was nearly fifty per cent. **Mr. Ghosh.**

The lifehistory is as follows: The eggs are small and are laid singly on a leaf or stem. The caterpillars bore the base of the new shoots (or, rather, the newly-forming stems); they may migrate to neighbouring shoots and bore into them from the side. Pupation takes place in the tunnel and, in order to facilitate the emergence of the imago, a silken tube is formed leading up to the surface of the soil. It is not possible to remove the caterpillars unless the shoot is cut flush with the surface of the sett. If the affected shoot is pulled sideways, after removing the earth from its base, it is easily dislodged from the sett, and in some cases the caterpillar comes up with the shoot. The life-cycle is about one month.

We now come to the insects boring in the stem of sugarcane. We find:— **Mr. Fletcher**

Diatræa spp.
Chilo simplex.
Scirpophaga xanthogastrella (*auriflua*).
,, *monostigma*.
Sesamia inferens.
,, *uniformis*.
Oryctes rhinoceros.

With regard to the question of *Diatræa* we are still rather in the dark as to the number of species which occur in India and their identity. Up to a few years ago any borer, found in cane, maize, *juar* and so on, was lumped under the name "Moth Borer" and was supposed to be *Chilo simplex*. On going over the Pusa Collection it struck me that the rather inadequate material lumped together as *Chilo simplex* really comprised more than one species, the specimens bred from cane being on the whole distinct from those reared from maize and *juar*. The difference became of practical importance in 1912 at Coimbatore when the new Sugarcane Station was started there because the surrounding country side was full of fields of *cholam* (*juar*) heavily infested with borers and, if this borer in *cholam* were the same as that attacking cane, the growth of cane on the Sugarcane Station would probably have been seriously affected. I therefore went into the question again with all the material available and came to the conclusion that, generally speaking, the borers in cane and in *cholam* were distinct. This is a conclusion which I have not seen occasion to modify so far, but at present I can only put it forward as a preliminary conclusion. We want to see a good deal more material from all parts of India and I shall be glad if any of you will assist by sending us in long series of specimens in good condition or by sending us parcels of cane, maize or *juar* affected by borers so that we can breed them out for ourselves. It is only by examination of long series in good condition that we shall be in a position to see what species really occur in different localities, by what points they may be separated, and what are the foodplants of each.

So far as I can say at present—it is, I repeat, only a preliminary opinion based on a comparatively small amount of material—we seem to have in India at least two, possibly three, species of *Diatræa*. One of these is perhaps *Diatræa venosata*, Wlk. (*striatalis*, Snell), which is well-known as a cane-pest in Java; it is probably distributed widely in the Plains of India and we have examples of this from Pusa, Ramnad, Jalalpur, Surat and Cawnpur. The second species is probably *Diatræa suppressalis*, Wlk. (*auricilia*, Ddgn.), which also seems to be widely distributed in the Plains of India, although we have no records from the Bombay side; this is probably the species figured in "South Indian Insects," fig. 298, as *Diatræa* sp. We have also a few specimens, reared from sugarcane at Pabna, of a *Diatræa* which may be an extreme form of the last species, or may be distinct. All of these forms of *Diatræa* appear to be distinct from *Chilo*, in the imaginal state, in structural details of neuration, but the neuration in *Chilo* appears on the other hand to be variable and a good deal of work will have to be done on the distinctions between *Diatræa* and *Chilo*, and between the various species concerned

in India, and for this we require ample material in the first place. As regards the larvæ, these appear to be very similar, but I expect that we shall be able to find distinctions when we are able to study sufficient material.

The position at present is that we appear to have in India two or more species of *Diatræa* which are especially attached to sugarcane but which are less commonly found in maize, *juar* and so on, and we have also *Chilo simplex* which is not rarely found in sugarcane but which is primarily a pest of *juar* and maize. The discrimination of these insects is not merely an academic matter of interest only to the systematic worker, but it is a matter of very practical value, when we come to deal with control by means of rotation of crops, or by trap-crops. I hope, therefore, that you will all assist by sending us ample material in the way of these borers. As these species of *Diatræa* and *Chilo* have been so confused together, we shall have to consider them for the time being simply as "Borers."

As regards their control, the cutting out of "dead-hearts" has been advocated and practised for many years and doubtless some of the Provincial delegates will be able to tell us something about that.

The collection of the egg-masses of the moths is also quite practicable, at least in the case of young plants. This is done regularly on the Farm at Taru, near Peshawar, the fields of young cane being gone over regularly every day and the egg-masses removed. If these egg-masses are placed in suitable receptacles, so that any parasites may escape, whilst the young larvæ will be unable to do so, this system of control may be improved still further. However, if hyperparasites are present, this method may do more harm than good; so here again we come up against the necessity for proper systematic work as being the basis of effective control-measures.

Some demonstration work in cutting out of "dead-hearts" has been done in the Punjab.

Mr. M. M. Lal. In the Punjab there is a good deal of trouble from borers in sugarcane. Maize and *Sorghum* were tried as trap-crops but it was found that the attack in the sugarcane was not reduced to any great extent.

Mr. Fletcher. That is what we should expect if the borers in cane are different from those in maize and *juar*.

Mr. M. M. Lal. The cutting-out of "dead-hearts" was tried next and was found successful. In the Punjab cane is sown in April and, if the cutting out is commenced as soon as the borer is noticed, the borer is controlled efficiently. Apart from the control of borers, another advantage which was derived from this practice was that the plants, from which the "dead-hearts" were cut out, tillered very well. The *gur* prepared

from the treated plots was 40 per cent. in excess of that produced from the untreated plots.

In the Central Provinces at Sindewahi and Tharsa Farms another experiment was tried to check the borers. Different plots of cane were planted on the 15th of each month from October to February. It was noted that those plots sown in October, November and December were not attacked so badly as the plots sown in January and February. This experiment was done because the borers hibernate during the cold weather.

It is probable, as shown by Mr. Taylor's experiments at Sabour, that an alteration in the time of planting would lead to bad results in other ways.

In Madras the attack of borers in cane is occasionally serious.

Thick cane is grown at Peshawar and there is considerable trouble from borers. The collection of eggs on young shoots is practised and it is fairly effective, as is seen on comparison of results from untreated and treated plots. The egg-masses of the borers can be seen easily by little boys who soon become adept at this work.

Cane planted in *Shaftal* (clover) suffers less from borer than cane planted in fallow land. This has been the experience of the cultivators in the North-West Frontier Province, and I can also confirm this.

The next borers are the two species of *Scirpophaga*, of which *S. monostigma* does not seem to be common and is hardly a pest, but *S. xanthogastrella* (*auriflua*) is common in most parts of the Plains of India and is a decided pest of cane. Both species are described and figured in "South Indian Insects" [pp. 425-426, figs. 302, 303] and we have a coloured plate of *xanthogastrella* in preparation. Control includes collection of egg-masses, which are fairly obvious on the leaves, and prompt cutting out of "dead-hearts," as in the case of the other borers. In the Central Provinces, where *Scirpophaga* has done considerable damage at Sindewahi, the early planting of setts, as described just now by Mr. Ratiram, has also proved advantageous.

At Pusa *Scirpophaga* is found in large numbers at the top of grown-up cane in winter, producing a bunchy effect. But it does more damage to young shoots, being the first borer to affect them after hibernation. The egg-masses are easily visible and collected from the leaves. If care is taken to destroy the tops with "dead-hearts" at the harvesting-time, the damage to young shoots is greatly diminished.

In the Punjab *Scirpophaga* is found late in the season in the cane crop.

In the Central Provinces *Scirpophaga* is only serious as a pest in the Chanda District. The variety of cane particularly attacked is *Sonapali* variety. **Mr. Ratiram.**

In the United Provinces *Scirpophaga* is generally found in cane from July to October. **Mr. David.**

The other caterpillar borers found in cane-stems are *Sesamia inferens* and *S. uniformis*. Their identity has been considerably confused in the past and I pointed out the differences between them in Entomological Note 62, Bulletin 59, and since that note was published we have reared *uniformis* from cane at Pusa. *S. inferens* seems to be the commoner species, but the habits of both are similar, so we can consider them together. Neither is confined to cane but both occur in maize also and we know *inferens* from paddy, wheat, *juar*, guinea-grass, *ragi* and *tenai*. **Mr. Fletcher.**

Sesamia in cane is a minor pest in Bihar. It usually occurs in the later stages of growth of sugarcane. **Mr. Ghosh.**

In the Punjab *Sesamia* is not found to attack cane much but is noticed in "Sarkanda" (*Saccharum ciliare*). **Mr. M. M. Lal.**

In the Central Provinces *Sesamia* is bad in Seoni and Bhandara. **Mr. Ratiram.**

Oryctes rhinoceros is very rare in India as a cane-borer but that it does occasionally occur is shown by figure 69 in "South Indian Insects," which represents a beetle caught in the act of boring into a cane-stem. I should not have included this in our Pest List on the strength of a single specimen obtained in this way but, in reviewing my book in the "Zoologist," Mr. W. L. Distant referred to *Oryctes* as having been a serious pest of cane in the Malay Peninsula when he was there some forty years ago. So it is quite possible that *Oryctes* may have a cane-boring habit in India more regularly than has been noticed. **Mr. Fletcher.**

The roots of sugarcane are attacked by various insects :—

Papua depressella.
Anerastia ablutella.
Termites.
Dorylus orientalis.
Myllocerus discolor.
Serica indica.
Pentodon bengalensis.
Anomala polita (*varians*).

Papua depressella has already been considered in its new aspect of a shoot-borer The larvæ occur commonly in cane-roots, especially of the ratoon crop, at Pusa, but do not seem to do much damage as a rule. It occurs throughout Bihar and the United Provinces and in the Punjab. It has also been bred occasionally from *Sorghum* and maize.

Anerastia ablutella has been recorded as a cane-pest in North Bihar but does not seem to have been met with during the last ten years. It may be a sporadic pest but is certainly not a pest in normal years.

Anerastia ablutella has been found in *Nagarmotha* grass (*Cyperus rotundus*) in large numbers in the Central Provinces.

We have never found it in *Cyperus rotundus* at Pusa. We should like to see some examples if you find it again.

Termites have already been described pretty fully under the heading of Setts, and I do not think there is any more to be said now. They sometimes damage cane-roots but are usually not serious pests of healthy cane in its later stages of growth.

Dorylus orientalis ["South Indian Insects," p. 274, fig. 111] occasionally attacks cane-roots much in the same way as termites and requires the same treatment. It is not a regular pest.

Myllocerus discolor [*Fauna of India, Curculionidæ*, Vol. I, pp. 348-350, fig. 106] is said to occur in the larval stage at the roots of sugarcane, being a serious pest in some districts; but this statement appears to be over-coloured. The larva feeds on young roots of cane, maize, *juar* and wild grasses, and can scarcely be considered as a pest as a rule.

Serica indica is stated by Lefroy ["Indian Insect Life," p. 251] "to have been reared from larvæ feeding on the roots of cane in Bihar and is one of the most common species," but we seem to have no specimens under this name in the Pusa Collection. Beetle grubs and pupæ, perhaps of this species, were found commonly on cane-roots at Pusa in March 1913.

It is a minor pest, found in the larval state throughout the year at roots of growing cane.

Pentodon bengalensis is rather unfortunately named as it is by no means confined to Bengal. It has been reared at Pusa from larvæ found in May at roots of cane and has also been reported from Peshawar as doing damage there by destruction of cane-roots by the larvæ, and the boring of new shoots by the adult beetles.

Pentodon bispinifrons [see Entomological Note 9, Bulletin 59] also occurs in cane-fields, and probably does similar damage. Both species of *Pentodon* seem to be minor pests of only local importance so far as cane-roots are concerned.

Anomala polita is the species hitherto known as *A. varians* in India, but it is doubtful what the true *varians* really is, and in India the name has been applied to two different species, *polita* and *bengalensis*, so it seems better to use the name *polita*. *Anomala polita* is described in Entomological Memoirs, Vol. II, No. 8, pp. 143-147, and there is

little more to say about its life-history. The larvæ occur commonly in cane-fields and sometimes damage the roots, but it is difficult to apply any control-measures directly. The adult beetles occur in the early summer and may be caught in numbers at that time. In this connection it may be of interest to note that last year, when we were working an Andres-Maire trap at Pusa in May and June, numerous examples of *Anomala* spp. were attracted and caught in the trap and it is interesting to note that larger numbers of *A. bengalensis* were caught than of *A. polita*, although the later is the commoner species at Pusa. An apparently trival observation of this sort sometimes gives a useful hint regarding control.

Anomala was rather bad last year round about Gurdaspur. The attack occurred when the plants were fairly young. Nothing could be done to check the pest. **Mr. M. M. Lal.**

We now come to the leaf-eating pests of sugar cane. We know of :— **Mr. Fletcher.**

Hieroglyphus banian.
Oxya velox.
Dasychira securis.
Telicota augias.
Leucophlebia lineata.
Marasmia trapezalis.
Phidodonta modesta.
Astycus lateralis.
Tanymecus sciurus.
„ *hispidus.*
Thrips.

Hieroglyphus banian (*furcifer*) ["South Indian Insects," pp. 531-532, tab. 50, figs. 1-3] is rather a pest of paddy in most districts and we shall come to it again when we deal with pests of the rice-plant. In some districts, however, notably in the United Provinces, it is a decided pest of sugarcane, and perhaps Mr. David will tell us about that.

In the United Provinces *Hieroglyphus banian* is a very serious pest of the sugarcane crop. In Azamgarh District it is at times so bad that after the attack the crop is reduced to half ; some years ago the attack was very serious, but it has not been reported of late. Ploughing up the fields in March and bagging the hoppers later on is practised. **Mr. David.**

In Mysore *Hieroglyphus* is found on paddy. I am of opinion that if the South-West monsoon rains are timely and heavy, that is, if they come at the time when the egg-capsules are just bursting, and the water soaks through the soil, the egg-pods are destroyed and there is no emergence. **Mr. Kunhi Kannan.**

But if there is a large emergence of hoppers, what do you do then ?

The hoppers after emergence remain on the field *bunds* for some time and eat the grasses which cover the *bunds*. It is quite an easy matter to bag the hoppers there. If that chance is missed, it becomes difficult to control them afterwards.

How wide are these *bunds* ?

They are quite narrow strips only to mark the boundaries between the fields and are perhaps a foot to eighteen inches wide on an average.

If the *bunds* are so narrow it would hardly be practicable to plough there to destroy the egg-masses. Do you practise ploughing the fields to do this ?

In Mysore, ploughing did not prove very promising. Our experience has been that the eggs are seldom laid in the fields but they are invariably found in the *bunds* or the areas close to the *bunds*.

In the United Provinces the eggs are found in the fields.

The local conditions are evidently different. In the United Provinces the eggs are laid in cane-fields, whereas in Mysore these fields are chiefly under paddy and are therefore probably not suitable for egg-laying.

At Cuttack the ploughing of the fields after harvest considerably reduced the number of the hoppers in the succeeding season.

Hoppers were reported from Siwan, Saran District, on one occasion and spraying with Sunlight Soap was reported as very effective.

In the Central Division of the Bombay Presidency *Hieroglyphus banian* occurs on *bajri*.

Our experience in the North-West Frontier Province has been that the field *bunds* are the chief source of trouble in connection with grasshopper attack. On the Farm at Tarn I have these *bunds* ploughed up and the result is that we have very little trouble with hoppers.

As regards sugarcane, the general experience seems to be that *Hieroglyphus* is only a real pest in the United Provinces.

Oxya velox [" South Indian Insects," p. 533, fig. 426] occurs on cane in most districts and is sometimes present in considerable numbers. I have seen it in large numbers on cane leaves around Peshawar, but it seems to be a minor pest of mature cane, eating the leaves but doing comparatively little damage. We shall come to this species also again under Paddy.

Dasychira securis is described and figured in " South Indian Insects," p. 397, fig. 265, and we have since issued a coloured plate showing its life-history. It occurs at times in some numbers on cane but is not much of a pest.

Telicota augias [" South Indian Insects," pp. 419-420, fig. 294] occurs in small numbers on sugarcane, the larva rolling the leaves, but it is at most a very minor pest.

Leucophlebia lineata has never been noticed as a pest of cane in India but has been described as a minor pest in Java and Formosa and may at times be found in India also. The life-history is briefly described and figured in Entomological Note 65, Bulletin 59.

Marasmia trapezalis [" South Indian Insects, pp. 432-433, tab. 33] occurs commonly on *juar*, maize and other cereals and occasionally on cane but is not a pest of cane.

Mr. P. C. Sen. In Bengal *Marasmia trapezalis* is noticed on cane leaves but only a small amount of damage is done.

Mr. Fletcher. *Phidodonta modesta* [" South Indian Insects," p. 315, tab. 9] occurs in most parts of India as a minor pest of sugarcane. It is known in the Northern Districts of Madras, in Bihar and from Surat in Bombay. The larva mines the leaves and the beetles also eat the leaf. Control is not usually required but, where this is necessary, the mined leaves and adult beetles can be collected and destroyed.

Mr. G. R. Dutt. The specimens from Surat and from Pusa, standing in the Pusa Collection under the name *Phidodonta modesta*, apparently belong to two distinct species.

Mr. Fletcher. It is quite likely that two or more of these *Hispinæ* occur on cane in India. This is another example of the need for exact identification. The Pusa species, whatever it is, is a very minor pest of cane.

Astycus lateralis we have from sugarcane at Tatkon, in Burma. It is not a pest of cane, so far as we know.

Tanymecus sciurus [*Fauna of India, Curculionidæ*, Vol. I, pp. 76-78, fig. 25] has been found on cane at Pusa on two occasions, and *Tanymecus hispidus* (*l.c.*, p. 98] has also been found on cane at Pusa, but both are not known to be pests.

Thrips occasionally occur on cane in most districts but we seem to know very little about them in India, so they probably do not do any great amount of damage.

Does anyone know of any other pests of cane-leaves ?

Mr. Ratiram. In the Seoni District of the Central Provinces *Cantharis actæon* eats the leaves of sugarcane and appears as a sporadic pest at the end of September.

Mr. Fletcher. We have never found it on sugarcane in Bihar. The end of September seems a very late date. In Bihar it is generally found in July [see Entomological Note 35, Bulletin 59].

Mr. Ratiram. In the Central Provinces Centipedes have been noticed to eat the leaves of sugarcane.

Centipedes are usually carnivorous. Perhaps Millipedes may be intended but we do not know of these as doing any damage in India.

The next group of sugarcane pests includes those found sucking the juices of the plant :—

Pyrilla aberrans.
,, *pusana.*
,, *perpusilla.*
Callitettix versicolor.
Phenice mœsta.
Aphids.
Aleurolobus barodensis.
Neomaskellia bergi.
Ripersia sacchari.
Pseudococcus (Dactylopius) sacchari.
,, ,, *sacchari foliii.*
Aclerda japonica.

The three species of *Pyrilla* are all very similar in general appearance and habits. In South India we get *Pyrilla perpusilla* [" South Indian Insects," pp. 493-494, fig. 381] but at Pusa we get mostly *P. aberrans* together with small numbers of *P. pusana* and *perpusilla*. I had a note on these Cane-hoppers recently [Note 97, Bulletin 59] and a lengthy Memoir by Mr. Misra is in the press and will be ready shortly and, as this contains all the information available, we need not go into this again now.

Callitettix versicolor is a small brightly coloured Cercopid bug often found on cane in some numbers. I found it in numbers at Tatkon in Burma in September 1914. We do not know anything about any damage done by it and it is probably not a pest.

Phenice mœsta also is often found in numbers on cane. It is described and figured in "South Indian Insects," p. 493, fig. 380, and is often found on cane-leaves in little colonies. It never does any damage so far as we know and the immature stages do not seem to occur on cane-leaves; possibly they live on the dead leaves and trash at the bases of the stems.

Aphids sometimes occur on cane but we seem to know nothing about them and therefore they are probably not of much importance as pests.

The Aleyrodidæ found on sugarcane in India include *Neomaskellia bergi* and *Aleurolobus barodensis*. The former is described and figured in "South Indian Insects," p. 507, fig. 394, and the latter in "Indian Insect Life," p. 749, figs. 524-525; but doubtless other species occur also. This is a group which badly wants working up in India and I gave last year a short summary of the present state of our knowledge

[Entomological Note 98, Bulletin 59]. As a rule Aleyrodids are minor pests but they occur sporadically in large numbers and may do considerable damage. In such cases they are aften checked by parasites and the rate of parasitization may reach a very high percentage; I think we have found as high a proportion as ninety per cent. parasitized and under such circumstances the outbreak is checked rapidly and nothing more need be done. If, however, as sometimes happens, parasites are absent or present in only quite insufficient numbers, the only remedy as a rule is to cut off and burn the affected leaves to prevent the damage from spreading.

We shall be glad to see specimens of any Aleyrodidæ found on cane or other plants, and of their parasites if these are obtained.

Mr. M. M. Lal. In the Punjab Aleyrodids are sometimes very bad on cane. From the affected fields a very small quantity of *gur* is produced; the effect of the attack is very noticeable on the cane-juice, which is rendered more watery. The Aleyrodids are parasitized, but this occurs late in the season after nearly all the damage is done.

Removal of the affected leaves in the early stages of attack is practised. One peculiarity about the attack that has been observed is that the damage generally commences from the corners of fields.

Mr. Jhaveri. Aleyrodids are noticed on cane in Bombay also but Ladybirds and *Chrysopa* come to the help of the cultivator.

Mr. David. In the United Provinces these Aleyrodids occur on sugarcane but not as pests.

Mr. Robertson-Brown. In the North-West Frontier Province ratoon and thin varieties of sugarcane are generally attacked by Aleyrodids.

Mr. Fletcher. We will go on to the Scale-insects found on cane. Our list is a very meagre one and here again we have a group of insects which has not yet been either collected or studied in India. A little work on Indian Coccidæ would doubtless double our present knowledge without much difficulty. Some of the species on cane are common and doubtless do a good deal of damage in the aggregate.

Ripersia sacchari is described and figured in Entomological Memoirs, Vol. II, pp. 128-129, tab. 12, figs. 10-13. This account deals with the form since called var. *oryzæ* by Green, found on rice-plants in Bihar, and it occurs on cane in much the same way, in dense colonies under the sheathing leaves, where it is difficult to get at it.

Pseudococcus (*Dactylopius*) *sacchari* is also found on cane, under the sheathing leaves, in much the same way as the last, but it is probably less common than *Ripersia sacchari*.

Pseudococcus (*Dactylopius*) *sacchari folii* has been described at some length in Entomological Memoirs, Vol. II, pages 23-24, 124-127, tab. 12,

figs. 1-7, and I do not think there is much to add. This scale is found on both surfaces of the cane-leaves and not, as a rule, under the sheathing leaves.

Aclerda japonica has been noted on cane at Partabgarh, United Provinces, and at Jubbulpur, in the Central Provinces. The scales occur on the nodes below the sheathing leaves, the space between the cane and the sheathing leaves being filled with a thick, flocculent, whitish substance. The specimens sent from Jubbulpur were parasitized by a Chalcidid. In the Central Provinces it is reported to occur after the rains are over and, if it appears earlier, to retard the growth of the young plants.

Has anyone anything to say about Scale-insects on sugarcane ?

At Coimbatore a mealy-bug, pinkish in colour, is found in masses at the joints and nodes of sugarcane under the leaf-sheaths.

A similar mealy-bug is found on thin canes at Tharsa, in the Central Provinces.

In the Punjab similar mealy-bugs were collected from soft-skinned varieties of cane.

There seems to be some doubt about the identity of these mealy-bugs, but *Ripersia sacchari* is usually the commonest species found on cane. It seems to occur in almost all districts and is found commonly on pulling back the sheathing leaves.

Has anyone anything more to say about sugarcane ?

In order to facilitate operations against insect pests of sugarcane, it would be an advantage if the custom, practised in some localities such as Bankura, of tying up old leaves around the bunches of cane, were followed. This practice keeps the field clear so that one can walk through it. In this connection I may mention that a coat and pantaloons of net, made of rope, is worn over their ordinary *dhoti* by cultivators working in cane fields in that district. The net saves the skin from being scratched by the leaves.

Saccharum spontaneum.

In most parts of India one finds various wild species of *Saccharum* and these may be of some importance in acting as alternative foodplants for cane-pests. At Pusa we get *Saccharum spontaneum* and on this we have found a Hispine beetle identical with that found on cane at Pusa (whether this is *Phidodonta modesta* or not seems doubtful, as we saw just now), and boring in the stem we find *Sesamia inferens* and *Phragmatoecia castaneæ*. *Sesamia inferens* of course occurs in sugarcane but *Phragmatœcia castaneæ* has never been noticed in cane hitherto. It

would be worth while to examine these wild grasses more carefully in all localities so as to find out exactly what insect fauna they support.

RICE (*Oryza sativa*).

Rice is far and away the most important crop grown in the Indian Empire and its pests are of great importance, and naturally there is a long list of them. We will take first the insects attacking paddy seedlings. **Mr. Fletcher.**

On seedlings we get :—

Spodoptera mauritia.
Thrips oryzæ.
Paddy Fly.
Crabs.
Apus.

Spodoptera mauritia [" South Indian Insects, p. 378, tab. 20] occurs on paddy, *juar*, cane and various wild grasses but is particularly a pest of paddy seedlings and often does considerable damage. The methods of control include :—(1) protection of seed-beds, by surrounding them with narrow steepsided trenches. If the seed-bed is separated by a ditch, a little oil may be poured on this to prevent caterpillars from crossing it. Such a method will not prevent the adult moths from reaching the seed-beds so we must (2) deal by hand-collection with any egg-masses laid. The eggs are laid in batches on the leaves and can be hand-picked, although this is not always easy. The larvæ usually hide in the daytime so that (3) trapping them under planks, sods, etc., might be tried. (4) The flooding of the paddy seed-beds, when attacked, and the turning in of ducks to eat the caterpillars is actually practised with success in some districts. (5) If the attack is very bad and all the seedlings destroyed before measures are taken, ploughing of the affected area should be done to destroy the pupæ in the soil. The moths are attracted to Andres-Maire traps at Pusa but we do not know as yet whether this method of control can be applied. The trouble with this species is that its appearance in destructive numbers is usually sporadic and cannot be foreseen.

In Burma the cultivators attract paddy-birds, crows and mynahs to attacked fields by placing cooked rice in trenches. **Mr. Shroff.**

In Assam last year *Spodoptera mauritia* came in large swarms and the only thing that was done against the second brood was that the field-*bunds* were scraped off and the pupæ collected and destroyed in thousands. Where there was water in the fields, the caterpillars were dislodged by dragging a rope over the crop, the water having been previously slightly kerosinized. **Mr. Gupta.**

How far were these measures adopted ?

These measures were adopted only on the Experimental Areas; but nothing was done in the fields of the cultivators.

Last year in Assam these caterpillars came in large numbers soon after the floods but this year we got *Cirphis unipuncta* instead of *Spodoptera.*

In the Central Provinces one year [? 1908] in August, *Spodoptera mauritia* appeared simultaneously in thirteen districts. In Balaghat District, it was found very serious and nothing could be done there: the result of the damage was that the affected fields appeared as if they had been grazed down by cattle. Eight days afterwards there was a very heavy downpour of rain, lasting for three days, and after the rain not a single caterpillar was found. New shoots were thrown out by the plants and the cultivators harvested a bumper crop. In the following year the same trouble was expected but the pest was reported from a few districts only, and the attack was not at all serious. Since then every year a few specimens are sent in from the districts but the pest has never reappeared in any large swarms.

In Assam *Spodoptera* is found most serious in paddy seed-beds.

In certain parts of Madras ducks have been found very useful in clearing the fields of these caterpillars.

In Burma it has been noticed that districts liable to floods suffer more from the attack of *Spodoptera.*

Thrips oryzæ is only known at present from Southern India but is probably more widely distributed, but overlooked at present. Even in Southern India it has only been recorded in the last two or three years and the insect itself was only described quite recently in the "Bulletin of Entomological Research" [Vol. VI. pp. 353-355]. It is not included in "South Indian Insects," but I saw an attack of it on paddy seedlings when I was at Coimbatore at the end of August 1915. The attacked plants had gone quite a light yellow colour as the result of the attack of this *Thrips.* As regards control-measures, in this case what was done was to pour kerosine oil onto the irrigation water running into these plots, until a film of oil was formed over the surface of the water, and then to draw a bamboo over the plants so as to submerge them. By this means the *Thrips* were killed off, but I did not see the result of the treatment, as I left Coimbatore.

Thrips oryzæ is very bad in some rice-growing tracts in Madras, on the seedlings. The attacked leaves turn a very pale yellow and have a sickly appearance as if they suffered from want of water. Good rains have been found to bring the attack under control in Madras.

Mr. Kunhi Kannan. Kerosine Emulsion, when sprayed on *Thrips*-affected leaves, scorches them. Spraying with water only would be useful.

Mr. Fletcher. A fly has been reared from paddy seedlings and is referred to in "Indian Insect Life" [p. 638, tab. 76, fig. 3], where it is placed in Cordyluridæ. The larvæ are said to live in the stems of young rice and to pupate there. It was reared at Pusa from transplanted paddy seedlings about ten years ago but since then it has not been observed to any extent and we seem to know very little about it.

Mr. Shroff. In Burma fly maggots have been noticed boring paddy seedlings in an isolated patch.

Mr. Fletcher. Crabs have come into notoriety lately, especially in Madras, as paddy pests. In Bihar we have only had one report of crabs attacking paddy, but about five or six years ago we had a report from Karachi of damage by crabs in fields of young paddy. Recently they have come into prominence in Madras and Burma and there seems to be no doubt that crabs do some damage to rice plants.

Mr. Ramakrishna Ayyar. In Madras reports of damage by crabs were received from the Kauveri delta last July and August. It has been observed that the damage may be very serious in areas where single seedling transplantation of paddy is done. It appears that the crabs have been attacking paddy for several years but the damage was not noticed before because the practice of transplantation was to put in bunches of several seedlings.

Mr. Fletcher. Have you found out anything about the life-history or habits of these crabs? It is a species of *Paratelphusa* which is concerned, I think.

Mr. Ramakrishna Ayyar. Yes; it is *Paratelphusa hydrodromus*, Hbst. Not much is known about the life-history. The mother crab carries the young under the abdomen.

The crab does not cut the paddy plants for the sake of feeding on the green portion but to extract the white pulpy inside portion of the stem.

Mr. Fletcher. What control methods have been tried?

Mr. Ramakrishna Ayyar. Many substances have been tried against these crabs. Crude Oil Emulsion was found to have no effect on them. After the crop was harvested, Carbon Bisulphide, Potassium Cyanide, and Kerosine Emulsion were poured into the holes found in the fields. These holes were examined sometime after and the crabs were found dead inside the holes.

Mr. Fletcher. If the fields are thus freed from crabs, do they remain free, or do more crabs come in?

Mr. Ramakrishna Ayyar. The fields will probably become reinfested but we have not yet been working for long enough to say as we cannot say for certain whence these crabs come. It is probable they will come in again with irrigation water from higher levels.

These fields in which you have been experimenting are small plots on the Paddy Breeding Station at Coimbatore, I think. If these are once freed, could they not be protected from reinfestation by surrounding them with a fencing of wire netting?

Protection with wire netting was tried but found ineffective, as the crabs crawled over the netting.

Will you tell us about crabs in paddy-lands in Burma, Mr. Shroff?

Land crabs are common throughout Burma, and are believed to do a considerable amount of damage to the paddy crops. They do not appear to prove troublesome in all places, but in certain restricted localities their depredations are said to be serious.

They are solitary in their habits. Two animals are rarely found in the same burrow except during the mating season or when the females carry their young. There is probably one breeding season and the eggs are produced and young are hatched in *Kason* and *Nayon* (April-June). Each female produces from 250 to 350 eggs which she carries about with her tucked under her tail. The newly-hatched young also accompany the mother for some time, probably a week or two and then separate to feed for themselves.

Nature of damage. These crabs burrow into the *Kazins* (*bunds*) and allow water to percolate through, thus causing paddy fields to dry up in some places. They also do some mischief by pinching off the stems of young paddy plants, chiefly of transplants, from *Wagaung* (July-August) to *Thadin-gyut* (September-October). They are said to prove very destructive in flooded areas. According to the report from the Tharawaddy District, fifty crabs will destroy plants covering a mat-space (about 120 square feet) of the field in one night. As they cause a good deal of damage in the aggregate it is impossible to estimate even approximately the destruction to an individual holding.

Their natural enemies. The chief enemies of this pest are herons, storks, cranes and other wading birds that visit paddy fields. These destroy the pest in large numbers, but on account of its prolific breeding, these feathered friends of the cultivator do not exercise any appreciable check on its increase. Besides, these birds sometimes favour some localities to the neglect of others.

Local means of control. The cheapest and surest method of controlling this pest, practicable in this country, is handpicking. Innumerable crabs are annually collected, partly (chiefly would be more correct) for human consumption and partly with the object of checking their depredations in paddy fields. The Burmese are very fond of this crustacean which they eat either fried or curried. Crabs collected in the rainy weather are not eaten by Burmans because they are said to

be poor in fat at that season. One method of securing the crab is to thrust the arm into the hole ; and the Burman does this with dexterity born of habit, so that he can haul out his quarry without even a scratch from its formidable pincers. Another ingenious method is to force down the soil near the mouth of the burrow, thus literally squeezing the crab out. Of course this operation is only feasible when the soil is soft. The cultivator's method is to bury in the irrigating channels, earthen pots with their edges well above the water. These pots are baited with bran or oil cake. Smelling the bait, and trying to get at it, the crabs tumble headlong into the pot and find themselves securely imprisoned, as climbing out is impossible. In some places the bait used is a roasted bean kneaded into balls with *kangyi* (boiled rice water). The fishermen of the British Isles are said to bait their pots with stinking fish. When the water is too deep to have the edge of the pot showing over the surface, the pots are buried on the sides of the *Kazins*. In the dry season a little water is poured into the hole and a wisp of twisted and sodden straw is wormed into the hole and out comes the crab. In most places the children combine business with fun at ploughing time by hunting for crabs in the fields. Although comparatively large numbers of this pest are thus annually collected and destroyed, these simple methods do not prove efficient for two evident reasons, namely, the prolific breeding of the pest and the isolated and irregular efforts on the part of the cultivators. Such random attempts towards the suppression of the pest can hardly be expected to affect its numbers appreciably. It is evident from an experiment recently conducted on the Mandalay Government Farm that by taking timely action incessantly for a certain period, a good deal of damage can be prevented. The following is a summary of the results of the experiment.

74,179 crabs were collected between 14th May and 30th June 1915 at a cost of Rs. 136-12-0 from an area of 130 acres. The approximate charges for catching 100 crabs was annas three or Rs. 1-0-9 per acre. An excess yield of 650 baskets was obtained from the 130 acres by crab-catching that is, five baskets per acre better yield than would have been obtained without crab catching or Rs. 5 per acre profit due to crab-catching. The area over which crabs were caught did not require to be replanted and the probable saving on this head is estimated at Rs. 1-8-0 per acre. Thus the total profit by crab catching on one acre is estimated at Rs. 6-8-0. From this must be deducted the actual cost of catching the crabs, *viz.*, Rs. 1-0-9, so that the net profit per acre amounts to Rs. 5-7-3.

Without putting themselves to any extra expense, the cultivators could secure the help of their womenfolk and children by getting them

to catch the crabs and the work would be all the easier, considering the limited sizes of the holdings. Again in *Kason* and *Nayon* and the rainy weather crab-hunting would be child's play as these creatures leave their burrows and come to the surface in the evenings and occasionally in the mornings. When they are not found on the surface, attempts may be made to pick them out from these holes as suggested above.

It must however be borne in mind that it is by means of co-operation and simultaneous action only that the pest can be checked. The crabs collected should not be thrown aside, but stored in an earthen jar or any other convenient vessel and allowed to rot. They then make an excellent manure. Like cray-fish, the crab, when boiled, mixed with meal and allowed to dry makes an extremely valuable egg-producing food for poultry. In Japan the following measures are resorted to :—(1) handpicking, (2) protection of the crops by surrounding the field with a straw mat, and (3) the use of the waste product in the tobacco factory (the midribs of the tobacco leaves) as manure and also into the burrows of the crabs. The second measure is, from its very nature, hardly practicable in Burma on account of extensive paddy fields. Much waste product of tobacco may be available from the local cigar-rollers and can be easily used as manure as well as into the burrows of the crabs. This measure deserves a trial in this province. It is likely to impart vigour to plants and also kill the crabs in good numbers.

In America, the following three methods of poisoning cray-fish have been devised which would no doubt succeed in case of our land crabs, but they are attended with serious disadvantages which would hardly bring them into the sphere of practicability in this country.

(1) *Carbon Bisulphide* is used in the burrows which are then immediately closed and its fumes kill the animals. The use of this stuff on a field-scale is not possible in this country for two reasons. First it is likely to involve greater expenditure than the collection even by hired labour would, and secondly, being a dangerous inflammable substance, it cannot be safely trusted in the hands of ignorant cultivators.

(2) *Chloride of Lime.* An ounce of a solution of Chloride of Lime (of the strength of one pound to 3 gallons of water) was found sufficient to kill the cray-fish in their holes. It is cheaper than Carbon Bisulphide but the time required to make the solution and haul it to the field practically offsets its cheapness and therefore it is said to have little or no advantage over Carbon Bisulphide.

(3) *Calcium Carbide* is said to be effective and useful on account of the ease of its application but the cost prohibits its use in large quantities. It is used only in burrows that are nearly perpendicular, as

otherwise it will not reach the water which is necessary for the development of the fatal gas.

In view of the disadvantages which the use of these poisons would involve, the most practical and economical means of controlling the crab-pest in this country would be simultaneous and regular collection by the cultivators of a locality where the pest is particularly prevalent and troublesome, at least during *Kason* and *Nayon*.

Mr. Fletcher. The use of earthen pots as traps seems a good idea and this might be tried in Madras.

Mr. Ghosh. With reference to the idea that crabs come in from higher levels with the irrigation water, their appearance and disappearance in the fields may, I think, be connected with the fact that crabs hibernate and æstivate in the ground. Many years ago I saw a crab resting in a cell at a depth of about four or five feet in the middle of a field where a well was being sunk. This was about April or May.

Mr. Fletcher. *Apus cancriformis* may be considered here. In May 1911 we received from the Settlement Commissioner, Jammu and Kashmir State, a parcel of specimens of *Apus* with the information that these animals, locally called *pahar*, occasionally do much damage to rice seedlings in the Banihal Ilaka south of the Pir Panjal range at a height of about 6,000 feet. The damage occurs in the first few days only of growth, mainly where the irrigation water is particularly cold, and is greater when the winter snow-fall is exceptionally heavy and melts late. This *Apus* is not known to occur at all in the extensive areas under rice in the Kashmir Valley, which is divided from the Banihal Ilaka by the Pir Panjal range, in this part from 9,200 to 14,000 feet in height ; nor does it seem to occur in the lower hills to the south.

The local method of control employed is to let the water out of the fields for some time. If still present after this, it is collected by hand and thrown out in the sun or into the nearest stream.

They are said to occur to some extent every year at the time of rice sowings but disappear again after a week or two. In 1912 they appeared between 21st and 28th June in Banihal villages of the Ramban tahsil, but are said to appear in the fields from April to June, but not to be seen at all during the other nine months of the year.

I have here some specimens of this animal [*handed around for exhibition*]. From a zoological view point it is of very great interest. In Europe it is found in muddy ponds and appears in a peculiarly intermittent manner. One year it may be found in abundance in a particular pond and diligent search will fail to reveal it there year after year afterwards, until suddenly it again appears in plenty. *Apus*, in fact, is generally looked on as a distinct rarity, only intermittently abundant,

and practically nothing is known of its habits; so the fact that it is a pest of paddy seedlings, even though this may happen in a remote part of Kashmir, is a distinctly new idea of great interest.

With regard to non-insect pests of paddy, we received a report of snails damaging rice-plants. I went to the place and found some snails sticking on the plants, but I could not be sure whether any damage was actually done by these animals.

In Burma snails do some damage to paddy plants.

Paddy seedlings are attacked by various grasshoppers, but it is difficult to draw a line between those feeding on adult plants and those on seedlings. *Epacromia* and *Œdaleus* are perhaps more often found on seedlings.

In one place in Madras paddy nurseries were badly infested with Surface Grasshoppers, among which *Epacromia tamulus* was noticed in very large numbers. The cultivators tried two methods :—(1) the use of long sheets of cloth in the form of bags in which to collect the grasshoppers, (2) the use of large palmyra leaves with long stalks, with which the grasshoppers were driven into one place, and, when they were collected in numbers, they were beaten to death.

In Madras the Texas Grasshopper bait (bran, Paris Green, and juice of fresh lemons) was tried against *Chrotogonus* with success in small plots, but when tried against *Colemania* the bait did not prove very successful.

We tried it at Pusa with *Chrotogonus* but it did not prove at all attractive. Perhaps the species of *Chrotogonus* was different.

We will go on with the insects attacking the leaves of paddy-plants. There is a long list and we will takethe Lepidopterous pests first. On my list I have :—

Cirphis unipuncta.
,, *albistigma.*
,, *insularis.*
,, *loreyi.*
,, *compta.*
Borolia venalba.
Spodoptera abyssinia.
Pelamia (Remigia) frugalis.
Dasyc' ira securis.
Nisaga simplex.
Mycalesis perseus.
,, *mineus.*
Melanitis ismene.
Junonia almana.

Ampittia dioscorides (maro)
Chapra (Parnara) mathias.
Caltoris (Parnara) colaca.
,, ,, *bevani.*
Parnara bada.
Telicota augias.
Brachmia arotrœa.
Nymphula depunctalis.
,, *fluctuosalis.*
Ancylolomia chrysographella.
Cnaphalocrocis medinalis.

Cirphis unipuncta ["South Indian Insects," p. 376, tab. 18] is widely distributed throughout India and is often a major pest of rice. We have examples reared on rice-plants from Poona, Pusa, Chittagong, Mymensingh, Goalpara, Dibrugarh, and Kamrup, but it also occurs throughout Madras, the Central Provinces and Burma.

Control is difficult and I do not think that any standard method can be laid down, largely because this species usually appears suddenly in large numbers, whence it has been called the "Army Worm." Unattacked areas may be protected if possible by trenches and oiling of intervening ditches. The caterpillars hide during the day time under clods and in cracks of the soil and pupation occurs in similar situations. When fields are badly attacked it is advisable to plough them as soon as possible after the crop is removed, to kill the pupæ remaining in the ground.

With reference to the sudden appearance of large swarms of this caterpillar, there is a note by Laurent in the *Entomological News* for January 1915 [Vol. XXVI, page 36] on an outbreak of *C. unipuncta* in Philadelphia in 1914, and Laurent states that it has often been "noticed that the army worm oftimes becomes a plague when a wet season follows a dry one, and this was just the condition of affairs around Philadelphia in 1914." In that case spraying with Lead Arsenate and sieving of dry slaked lime over the infested areas were found effective control measures; but such methods are hardly practicable in the case of rice areas in India, as a rule. It would be interesting to know whether there is any general rule in India governing the appearance of swarms of these caterpillars and in this connection exact information of any such outbreaks will be very useful.

In Burma *Cirphis unipuncta* is very serious in some districts. **Mr. Shroff.**

In Assam *Cirphis unipuncta* appeared last year just after the floods. **Mr. Gupta.**

In Southern India, *Cirphis unipuncta* has been observed to appear after heavy rains. **Mr. Ramakrishna Ayyar.**

That seems to confirm the experience in America, but we require a number of exact records of the occurrence of this, and all other common insects, before we can be in a position to prophecy regarding outbreaks of insect pests.

Was anything done in Assam to control this insect?

The caterpillars could be found on rice-plants from just after dusk until morning, so a rope was dragged over the crop from 6 P.M. to 10 P.M. and again early in the morning, to disturb the caterpillars. Heaps of grasses were also placed in the fields during noon-time and the caterpillars came under these heaps to take shelter, and were there collected and destroyed.

In the Central Provinces *C. unipuncta* has been found to cut green ears of paddy.

Cirphis albistigma has occurred at Manganallur, in the Tanjore District in Madras, on paddy just ripe for harvest, the caterpillars cutting off the ear-heads; it occurred in large numbers and did considerable damage. This species has also been bred at Pusa from a larva on rice-leaves and from another on Gramineæ (species not specified) and we also have moths from Pusa and the Shevaroy Hills.

In Southern India two outbreaks of *Cirphis albistigma* have occurred during the past few years. This pest is bad after heavy rains and it appears when the paddy is just ripening, the ears being cut off by the caterpillars. It has become a very serious pest in South Arcot, Chingleput, and the adjacent districts. An Andres-Maire trap was put up in the attacked fields and attracted some moths. The life-history has been worked out at Coimbatore and two coloured plates have been drawn [*exhibited*].

In Bengal *Cirphis albistigma* has been found to do similar damage.

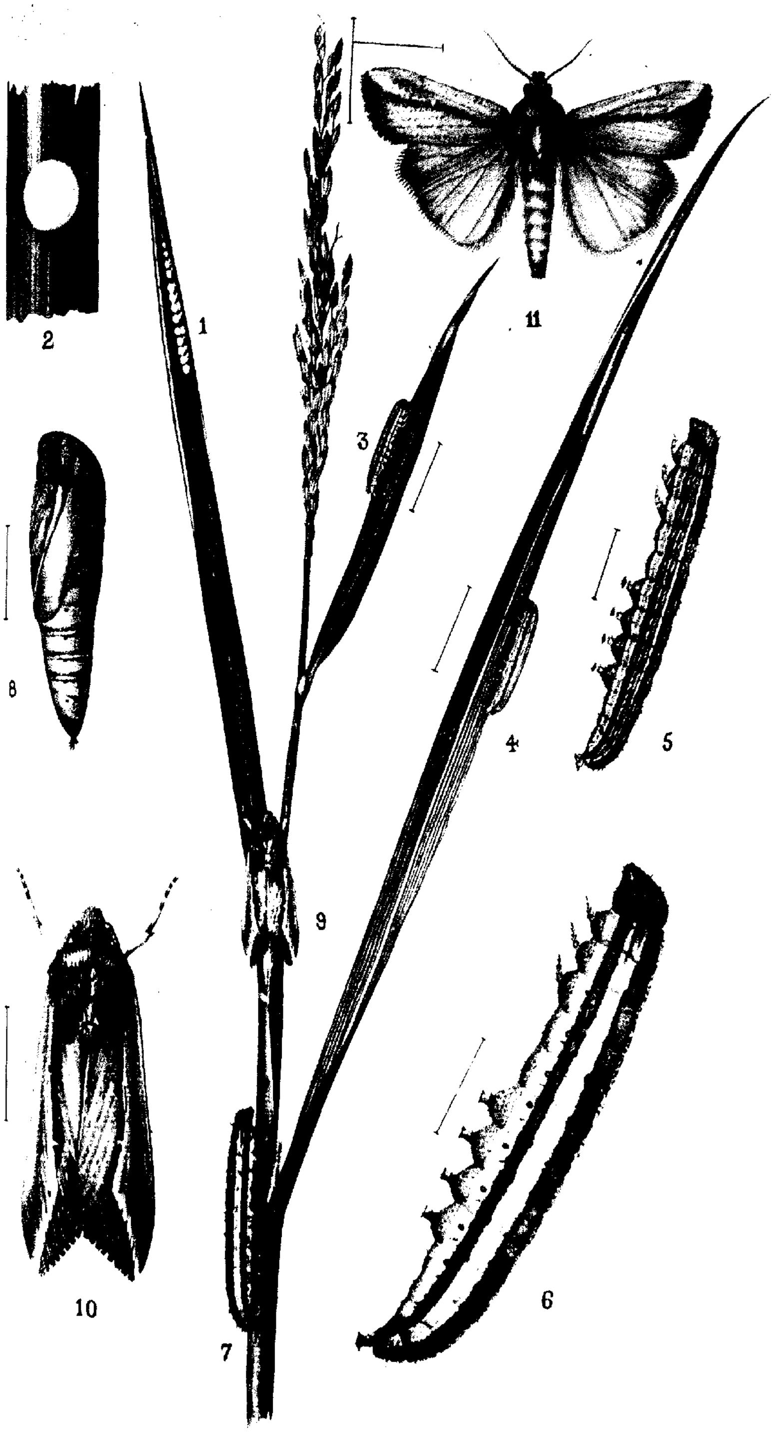
Cirphis insularis has been bred at Pusa from larvæ on *dubh* grass and in some numbers from larvæ found on rice leaves, but has never been recorded as a pest.

Cirphis loreyi occurs throughout India as an occasional pest of most Gramineæ, often occurring together with *C. unipuncta* and hence liable to be overlooked. There has been a good deal of confusion in the past about the identity of these various species of *Cirphis*, practically everything that was not *unipuncta* being lumped together as *loreyi*, but the true *loreyi* is readily distinguishable in the male sex by the fan-shaped tuft of leaden-coloured hair-scales at the base of the lateral margin of the abdomen.

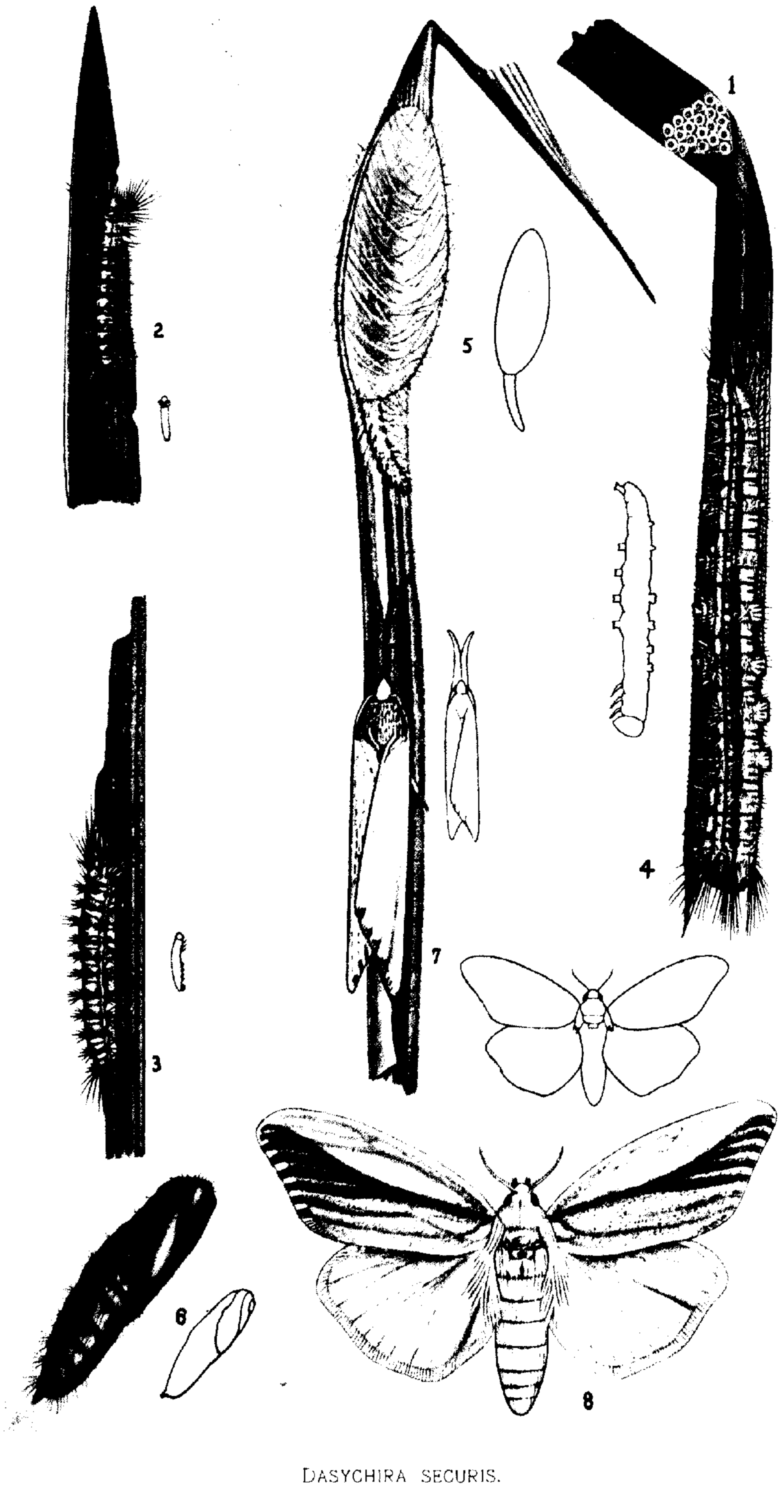
C. loreyi has been reared at Pusa on rice and probably occurs on rice in most parts of India.

Cirphis loreyi.

Figs. 1 and 2, eggs in natural position and one enlarged.
Figs. 3 to 7, caterpillars, natural size and enlarged.
Fig. 8, pupa, enlarged.
Figs. 9, 10 and 11, moth, natural size and enlarged, showing resting and flying attitudes.



CIRPHIS LOREYI



DASYCHIRA SECURIS.

Dasychira securis, Hb.

Fig. shows an egg cluster;
Figs. 2, 3 and 4 show the caterpillar in different stages of growth;
Fig. 5 is a cocoon on the leaf, and
Fig. 6 the pupa;
Fig. 7 shows the moth in its resting attitude, and
Fig. 8 the moth with wings expanded.
Figures in outline show the natural sizes.

Cirphis compta is said to have been found on paddy in Southern India (Coimbatore and Madras), but does little damage. It may be a sporadic local pest. We seem to know very little about it at present.

Borolia venalba is widely distributed in India and is an occasional pest of rice, especially in Southern India. It has been found feeding on rice-plants at Pusa, Manganallur (Tanjore District) and Puraswakam (Madras). In Madras it seems to occur chiefly in May and October. In July 1902 it was found destructive to rice at Tangalla, in Ceylon.

Spodoptera abyssinia was found attacking paddy at Coimbatore in August 1916. The Pusa Collection contains moths from Peshawar, Pusa and Coimbatore, and the species occurs throughout Peninsular India. It is probably common on rice, but has been overlooked.

Pelamia (Remigia) frugalis [" South Indian Insects," pp. 388-389, fig. 253] occurs throughout India on various grasses and is an occasional pest of the rice-plant.

Dasychira securis is described and figured in "South Indian Insects", p. 397, fig. 265, and we have since issued a coloured plate showing the life-history. It is a minor pest of paddy. The caterpillars are conspicuous and feed exposed, so may be hand-picked.

Nisaga simplex occurs in most grassy areas in Western and Central India. We have examples from Belgaum, Poona, Pachmarhi, Ranchi and Pusa, and I have seen the larvæ at Mercara, in North Coorg. The caterpillars are found on wild grasses and sometimes occur literally in millions, but seem to do little harm to crops as a rule. Occasionally they have been known to invade paddy areas and to do a little damage.

Nisaga simplex is a minor pest of paddy, found on rice-plants only once, at Ranchi. It has only one generation in the year and at Pusa rests as a pupa from about September to July. **Mr. Ghosh.**

Mycalesis perseus is sometimes found on rice at Pusa in small numbers, but is not a pest. **Mr. Fletcher.**

Mycalesis mineus. Pupae of this species have been found at Gauhati on rice-leaves, so presumably the caterpillar feeds on the rice-plant, but it is not known as a pest.

Melanitis ismene is described and figured in " South Indian Insects ", p. 412, tab. 50, figs. 7-9, and has since been described in Entomological Memoirs, Vol. V, pp. 3-7, tab. 1. It occurs throughout India, Burma and Ceylon, and is a minor pest of the rice-plant.

Junonia almana [" Indian Insect Life," p. 413, fig. 282] occurs throughout India, Burma and Ceylon and has been reared from larvæ found on rice, *Mimulus gracilis* and *Rungia parviflora*. It has been

recorded on one occasion as found in large numbers destroying rice-fields together with larvæ of *Spodoptera mauritia*, but is not otherwise known as a rice-pest, and this record requires confirmation.

Ampittia dioscorides (*maro*) occurs in Sikkim, Burma, South India and Ceylon. It has been reared from caterpillars on rice and grasses, but is not known to do any damage to paddy.

Telicota augias is common throughout the Plains of India. It feeds as a rule on sugarcane but is also said to feed more rarely on bamboos and on rice. It is not a pest of paddy.

Caltoris (*Parnara*) *colaca* is also common throughout the Plains of India. We have examples reared on paddy at Pusa and Chingleput but it is scarcely a pest of paddy.

Caltoris (*Parnara*) *bevani* occurs in Burma and throughout the Plains of India, except in the South. We have examples reared from rice-leaves at Pusa and Samalkota but it is not known as a pest of paddy.

Chapra mathias was described and figured in "South Indian Insects", pp. 417-418, tab. 27, and again more recently in Entomological Memoirs, Vol. V, pp. 67-72, tab. 9. It occurs throughout India, Burma and Ceylon. We have examples reared from larvæ on rice from Nagpur, Pusa, Daltonganj, and Thana District. It is a minor pest of paddy as a rule, said to be serious in Travancore, and sporadically bad in most districts; but it may be observed that several of the preceding species of Hesperiadæ have been lumped together with *Chapra mathias* in a good many cases.

Chapra mathias was once reported in Burma as doing damage in the Upper Chindwin District.

Parnara bada is common throughout the Plains of Southern India, Burma and Ceylon, and occurs at least as far North as Bihar and Bombay. We have examples bred from caterpillars found on rice leaves at Ranchi, Daltonganj and Karwar. This species has not hitherto been recorded as a pest of paddy, but often occurs on this crop in large numbers. It has probably been overlooked and confused with some of the other species.

Brachmia arotræa is a small Gelechiad which has been bred in small numbers from larvæ on rice leaves at Pusa and Katni (Central Provinces). We have it also from Cuttack and Palamau, and it occurs in Burma and Ceylon. It is therefore likely to be found on paddy in most districts but is not a pest, so far as we know.

Nymphula depunctalis ["South Indian Insects", pp. 430-431, tab. 32] occurs throughout India, Burma and Ceylon as a minor pest of paddy, sometimes serious, especially in water-logged tracts. Draining the water off the affected fields is effective when this can be done but is

not always advisable from a cultural viewpoint nor is it generally possible in the case of low-lying lands, which are usually attacked most badly. In such cases the caterpillars can be controlled by spreading a film of oil over the surface of the standing water and dragging a rope or bamboo over the plants to dislodge the larvæ and suffocate them as they lie on the water or crawl up again.

Mr. Ramakrishna Ayyar. *Nymphula depunctalis* is frequently reported from the Malabar Coast. As regards control there, a common practice is to drag a thorny bush over the fields.

Mr. Ramachandra Rao. Another practice in Malabar is to collect the larval cases in a sort of winnow, which is used like a hand-net.

Mr. Kunhi Kannan. In Mysore oiling the rice-fields is practised.

Mr. H. L. Dutt. At Sabour, in Bihar, this pest occurs every year and is controlled on the Farm by oiling the fields and then dragging a bamboo over the plants until their tips touch the oily water. This is practised regularly and found successful.

Mr. Gupta. In Assam the same method of control is practised.

Mr. Fletcher. *Nymphula fluctuosalis* occurs throughout India, Burma and Ceylon, but has only been bred at Taliparamba in Malabar, when it was reared from a pupa found on paddy. It is perhaps a pest of paddy, together with *N. depunctalis*, but has not been definitely recorded.

Ancylolomia chrysographella is figured and described in "South Indian Insects", pp. 424-425, fig. 301, and we have lately prepared a new coloured plate showing its life-history [*exhibited*]. In Madras it was found on one occasion doing damage to young paddy plants, the larva living in silken galleries at the roots of the plants. Will you tell us about it, Mr. Ramakrishna Ayyar?

Mr. Ramakrishna Ayyar. On the occasion when it was doing damage, paddy had been sown broadcast in sandy soil along the sea-coast. The caterpillars were observed cutting the seedlings, when about a foot high, and carrying them into their galleries. Crows and other birds were very active in removing and eating the caterpillars.

Mr. Ghosh. At Pusa *Ancylolomia chrysographella* has never occurred in any numbers on paddy. It is found on grasses, especially in areas which have not been ploughed and which are overgrown with long grasses (*Panicum* spp.). The eggs are laid probably on the soil amongst the foodplant. The larva has the habit of forming a sort of a silken tube, into which the plants are woven; this tube goes into the ground. Pupation takes place in the larval tube. Ordinarily the life-cycle takes about a month. At Pusa the winter is passed in hibernation in the larval stage. The moths come to light freely.

Cnaphalocrocis medinalis ["South Indian Insects", p. 432, fig. 308] occurs commonly throughout India, Burma and Ceylon, and is a minor pest of paddy, sporadically rather serious. In the Northern Circars of Madras it has been noted that it is the late transplanted varieties of paddy that are generally attacked. We have examples reared on paddy from Pusa, Poona, Surat, Belgaum, Palur (South Arcot) and Parlakimedi (Ganjam).

Cnaphalocrocis medinalis is found in Madras in Godavari and Vizagapatam. Plants that are transplanted late suffer most. The affected plants revive later on but they are liable to be attacked by *Schœnobius bipunctifer*. One cultivator, a very intelligent man, tried an experiment in late transplantation, and experienced difficulty due to this insect. No control measures are possible.

We will next take the grasshopper pests of paddy. Besides those hoppers which attack the seedlings and plants more or less casually, there are two grasshoppers which are specific pests of the rice-plant :—

Hieroglyphus banian.

Oxya velox.

Hieroglyphus banian (*furcifer*) has already been considered at some length under sugarcane. In some districts it is a bad pest of rice and there has been a good deal of literature on it in India ; in Mysore there has been published a Bulletin on this species and the *Agricultural Journal of India* lately included an account of co-operative bagging against this pest in the South of the Bombay Presidency.

Hieroglyphus banian occurs in Dharwar and Belgaum, but not in Gujarat. Bagging has been found useful in controlling it.

In the Central Provinces *Hieroglyphus banian* is found in large numbers in the Chhatisgarh Division. Bagging has been very successful and nearly 2,000 bag-nets have been made to date.

In Bihar it occurs around Pusa in the paddy-fields but has never been found in large numbers or as a regular pest.

Its occurrence as a pest of paddy seems to be restricted to particular areas, in which it has been found that it can be controlled by bagging.

Oxya velox is also found in paddy areas in most parts of India and is usually a minor pest, occasionally doing a good deal of damage, and in any case it is probably responsible for a large money loss every year in the aggregate. It is described and figured in " South Indian Insects," p. 533, fig. 426, and it is there stated that the life-history is unknown, meaning that it was not known in detail. It has since been under observation at Coimbatore and it has been found that the egg-masses are usually not laid in the ground, as is the case with most grasshoppers, but are laid on the bases of *juar* stalks, etc.

Oxya velox has been under observation in the Insectary at Coimbatore and its lifehistory has been worked out. Under natural conditions the eggs are laid on the stalks whilst the stubble is in the field; later on, in the field *bunds*. In April and May the eggs hatched in 14 days, in about 3 weeks during the monsoon, and in 4 to 5 days during the winter, at Coimbatore. The grasshoppers are found to damage the ears of paddy sometimes. When paddy is not available, they feed on grasses. **Mr. Ramachandra Rao.**

As regards control-measures, hand-netting has been found quite useful.

In Burma *Oxya velox* was sent in in large numbers from Bhamo as attacking paddy. **Mr. Shroff.**

Oxya velox is ordinarily found in grasses and it is only under exceptional circumstances that they come into paddy. **Mr. Ghosh.**

The conditions evidently vary in different localities. In Madras they apparently prefer paddy. **Mr. Fletcher.**

We will go on to the beetle pests of paddy.

Hispa armigera (*ænescens*).
Leptispa pygmæa
Hapalochrus fasciatus.
Oides affinis.
Tanymecus chloroleucus.
,, *indicus.*
,, *hispidus.*
Myllocerus discolor.
,, *blandus.*
,, *dentifer.*
Athesapeuta oryzæ.

Hispa armigera ["South Indian Insects", pp. 315-316, tab. 10] occurs in most paddy-growing districts in Southern and Eastern India, but we have no records from the United Provinces or further North. It is sporadically a serious pest in Madras, Bengal and Orissa; apparently less common in Bihar but sometimes a pest even there, chiefly in nurseries. The larvæ mine the leaves of paddy and the pupa is found in the leaf whilst the beetles also occur on the leaves. Collection in bag-nets or hand-nets may be tried where it can be done.

In Mysore and Cuddapah lands irrigated from tanks, and in Malabar rain-fed lands, suffer most from *Hispa*. **Mr. Ramakrishna Ayyar**

As regards control, in Salem there is a curious custom of smearing a long stick with pig's fat and placing it in the middle of the fields where it is burnt, and it is believed that the smoke drives away the beetles.

In Lower Burma there is a local belief in the efficacy of the leaves of a particular plant, whose exact name I cannot give. These leaves are thrown in the irrigation water, or in the water standing in the fields; they give out an offensive smell which is believed to drive away the beetles.

In Assam *Hispa armigera* is a very bad pest. Nothing has yet been found useful to check it.

In Madras hand-netting has been found quite useful.

I have noticed an egg-parasite of *Hispa armigera* and on one occasion the eggs were found parasitized in fairly large numbers.

My Assistant reared *Hispa armigera* from grasses.

In the neighbourhood of Pusa *Hispa armigera* occurs every year, but in small numbers.

Leptispa pygmæa is figured and described in "South Indian Insects", pp. 313-314, fig. 165, and we have since issued a coloured plate showing the life-history. It is a species which seems to be confined to Southern India and Bombay. We have some specimens labelled "Pusa; R.M.P.; IX 1912" but I believe that these specimens really came from Travancore and were mislabelled. It occurs as a pest chiefly in South Kanara, Malabar, Travancore, Cochin and Mysore. In Bombay it occurs as far north as Bassein Fort but it does not seem to be a pest in Bombay. Indeed, its activities in the pest line seem to be confined to districts with a heavy rainfall, and it is said to be worst in wet weather. The life-history is briefly described in my book and control will be much as for *Hispa*, by collection in bag-nets or hand-nets.

In Southern India it is found all along the West Coast and perhaps the Coconada Division is its limit which it does not appear to have crossed yet.

Hapalochrus fasciatus is a Melyrine Malacodermid which was found on rice in small numbers at Pusa in July 1915 and which we also have from Chapra "on rice". It is not known to be a pest.

Oides affinis ["South Indian Insects", p. 313, fig. 164] was found on paddy at Shoranore, in Malabar, in July and August, but it seems very doubtful whether it really feeds on paddy. The allied *O. bipunctata* feeds as a larva on *Vitis trifolia*.

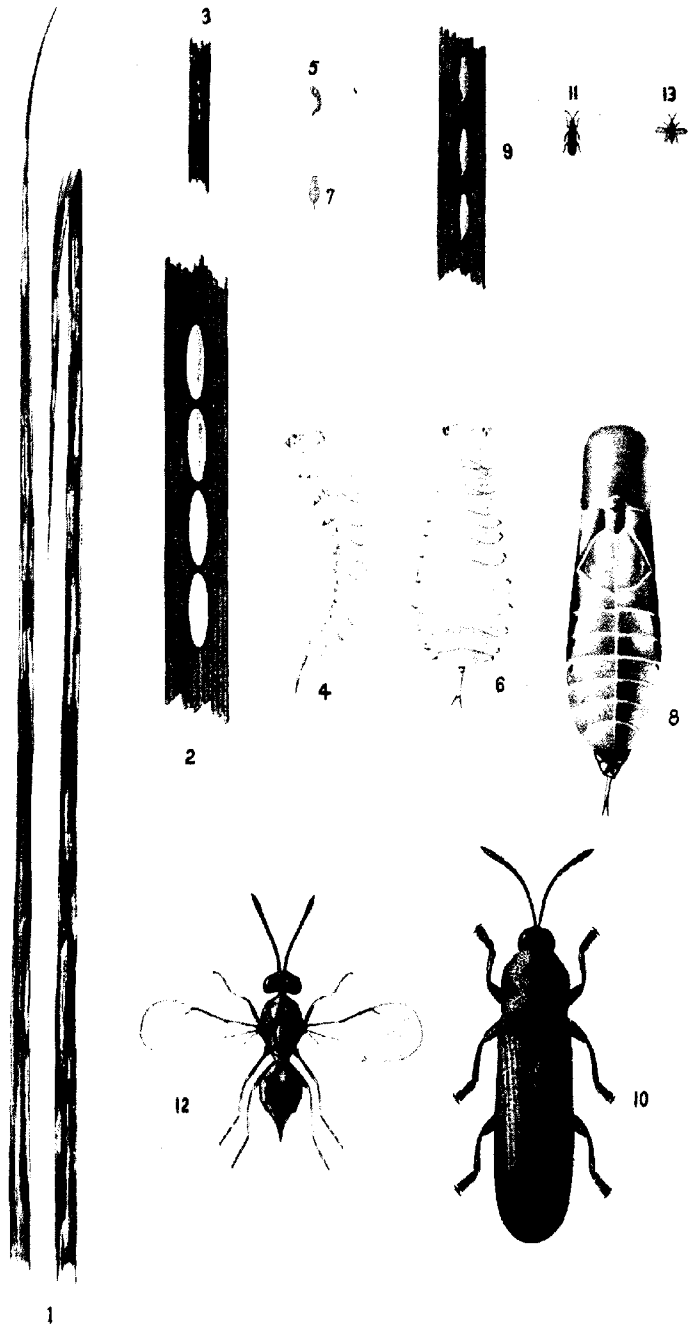
It was once found in large numbers on paddy at Shoranore, but has never been reported again.

Tanymecus chloroleucus has been found on paddy on two occasions at Pusa, *T. indicus* at Pusa and Chapra, and *T. hispidus* at Pusa; but none of these are pests.

Myllocerus discolor and *M. blandus* have been found on paddy at Pusa, and *M. dentifer* at Shoranore; but none of these are pests.

Leptispa pygmæa, Bly.

Fig. 1, Damaged leaves of paddy ;
Figs. 2 and 3, Eggs on a leaf, magnified and natural size ;
Figs. 4 and 5, Grub, lateral view, magnified and natural size ;
Figs. 6 and 7, Grub, dorsal view, magnified and natural size ;
Figs. 8 and 9, Pupa, magnified and natural size ;
Figs. 10 and 11, Adult beetle, magnified and natural size ;
Figs. 12 and 13, Chalcidid parasite, magnified and natural size.



LEPTISPA PYGMÆA.

PACHYDIPLOSIS ORYZÆ.

Pachydiplosis oryzæ, Wood-Mason.

Fig. 1, a cluster of rice plants several of which are affected.
Fig. 2, an affected plant, with the pupa in its natural position exposed.
Fig. 3, egg enlarged.
Fig. 4, full-grown maggot.
Figs. 5 to 7, different views of pupa.
Figs. 8 and 9, the adult fly in sitting and flying attitudes.
The small outline figures indicate natural sizes.

Athesapeuta oryzæ is another weevil, recently described by Dr. Marshall from specimens collected in Madras on paddy, but it is not common and seems to occur mostly on wild grasses.

Mr. Kunhi Kannan. In addition to these insects, in Mysore we have found a Dynastine beetle, as yet unidentified, infesting rice plants in fields with standing water. It lives in the water, coming up to the surface at times to breathe, and can remain under water, after one breathing, for an interval of time from one minute up to twelve hours. It damages the rice plants from the base upwards. [*Specimens were exhibited.*]

Mr. Fletcher. This seems to be quite a new pest with very remarkable habits for a Dynastine. I do not know of any other aquatic species of this group. It would be interesting to know more about it and its life-history.

We will take next the insects found boring in the stems of the rice-plant. This group does not contain many insects but they are of great importance as pests. On my list I have :—

Pachydiplosis oryzæ.
Schœnobius bipunctifer.
„ *immeritalis.*
Scirpophaga gilviberbis.
Chilo simplex.
Sesamia inferens.

Pachydiplosis oryzæ is a Cecidomyiad fly, hitherto called *Cecidomyia oryzæ*, which seems to occur chiefly in Madras, Orissa and Bengal. Some work on its lifehistory has been done, both at Pusa and Coimbatore, since our last Meeting, and a coloured plate showing its life history has been issued. Perhaps Mr. Ghosh will tell us his experiences with this insect ?

Mr. Ghosh. In the early part of September 1915 I went to Ranchi to investigate the disease of rice-plants caused by this Cecidomyiad fly and made some observations which I have incorporated in a report. Anyone specially interested in this pest can see the report.

The external symptom of the disease is the growth of a long hollow structure in place of the main stem. This coloured plate [*exhibited*] clearly shows it. It is caused by the maggot of the fly, feeding inside the stem. When the gall appears the maggot has already done the damage and has pupated. The fly issues from the gall in the course of a few days and then the gall withers. There is thus an end of the career of the plant which does not produce any ear.

There are some obscure points in the life-history of the fly. It is not definitely known where eggs are laid in nature and how the maggot gets inside the stem. In the Insectary I got some eggs which

were all laid on the surface of the water and none on the plants. I could not however get any plants infected.

This fly is a major pest of paddy plants and in some years causes serious damage which may amount to about 50 per cent.

The maggot can attack only young plants. Grown-up plants become immune. The greatest damage is done at Ranchi about August and therefore in years in which the transplanting operations are late. The damage is insignificant in years in which the operations are early and the plants grow to some height by about August. Remedial measures in this case are out of the question as the working of the pest is obscure and its presence is revealed only after the damage has been done. We have to rely on preventive measures alone and in order to find them out a good deal of investigation and experiment is necessary.

I have seen Mr. Ghosh's report and agree with him on all points except the method of oviposition. In the Insectary at Coimbatore I have found 4 to 10 eggs on the plant, generally at the base of the leaves. I have found parasites searching out and ovipositing in the Cecidomyiad eggs.

In Madras this pest was studied in 1914. The cultivators know it well and it is called *Anaikombu* (Elephant's Tusk). Recently a serious attack was reported from the Godavari District, and several experiments were tried in varying the dates of transplantation. Plants transplanted late suffered most.

At Coimbatore specimens were attracted to light. This led to an examination of the neighbourhood and sixteen kinds of grasses were found to develop galls in a similar way. Later on it was found that several distinct species of flies had been bred out and that each of these species restricted itself to one particular variety of grass. A species of *Panicum* at Samalkota was noticed to develop a gall-formation similar to that characteristic of *Pachydiplosis oryzæ* and the fly, on emergence, resembled the gall-fly in paddy.

As regards control, experiments will be tried with light-traps, as it has been found that the flies are attracted to light.

It remains to be seen whether the flies attracted to light are the same as those which produce these galls in paddy. As regards control, direct control-methods will obviously be of no use, since, by the time that damage is noticed by the presence of the galls, the damage has all been done, and it is then too late to avert it, the flies having emerged, or being about to emerge, when it is noticed. It will be necessary to make a careful study of the life-history of this insect and to adopt preventive measures, such as the use of early-maturing varieties of paddy, to prevent damage.

Schœnobius bipunctifer is far the most important pest of paddy, which is itself the most important crop in the Indian Empire, whether reckoned by acreage or value of out-turn. I have estimated the damage done by this one insect in Southern India alone as one hundred millions of Rupees annually and this figure may well be doubled or trebled when we consider the areas under paddy in other parts of India and Burma. Its life-history has been described briefly in "South Indian Insects", pp. 426-427, tab. 29, and the control methods suggested there are (1) use of light-traps, (2) collection of egg-masses, (3) destruction of paddy-stubbles. With regard to (1), we have made some experiments with light-traps in paddy-fields at Pusa, and similar experiments have been made at Coimbatore and Poona, and the general result is that, whether the lamps used are ordinary small oil lamps or powerful incandescent lamps, although the moths may be attracted in thousands, there is no perceptible diminution in the severity of attack, and the use of light-traps as a means of control seems to be a failure. As regards (2), the eggs are laid in masses on the leaves and may be hand-picked in small plots but this is not possible on any large scale. As regards (3), the destruction of stubble after harvest seems to offer a promising solution of the difficulty of control, in some districts at all events. In Bihar, for example, at any rate around Pusa, the stubble is often left in the ground during the winter months; we have collected and examined this stubble and found about 40 per cent. of the stalks containing borers, largely hibernating larvæ of *Schœnobius*. Destruction of the stubble at this time of year should do a great deal towards reducing attack on the next rice-crop and such destruction, if continued on a sufficiently extensive scale, should do something towards permanently reducing the attack in a district. But, before advocating such measures, we must make an extensive study of the insect concerned. We want to know, for example, if any parasites are carried over in these larvæ resting in the stubble and what will be the effect on parasitization of destruction of the stubble.

Mr. Ramakrishna Ayyar.

In Madras light-traps have been tried to attract the moths, and large catches have been secured; but still the pest has been observed to be as bad as before.

On the Farm at Coimbatore the affected plants are uprooted from the beginning; this was tried and found quite practicable. To estimate the cost of this measure it was applied to a plot of one acre last July; it was found that, in order to remove all attacked plants, four coolies were required for four days, and therefore this method would appear to be prohibitive as regards cost and labour. The cultivators themselves do nothing to check the pest.

In the North-West Frontier Province, soon after, and sometimes before, rice is harvested, clover is sown in the rice-fields, the result being that the rice-stubble is soon covered up by the clover and rots away and thus become unsuitable to carry on borers. The same thing is done in the Godavari delta, pulses and *gingelly* being sown. In Bombay, on black soil, the lands are ploughed up soon after harvest, and castor is sown. My idea is that such practices are responsible for the diminution of trouble caused by borers in such tracts. This has been confirmed at Peshawar in the case of sugarcane borers ; in cane-fields which are planted with a crop of *Shaftal* before the cane setts are put in, there is almost an absence of borers.

I think that light traps against *Schœnobius* should be given a trial over whole blocks at a time. Trials on a few acres in the middle of a block will not give satisfactory results.

There is no doubt that *Schœnobius bipunctifer* is the most important insect pest that we have in India and we want to know a great deal more about its exact life-history in all districts. It is one of those insects regarding which there is urgent need for intensive research, not in one or two districts or Provinces, but throughout the Indian Empire as a whole. It is not, of course, confined to India but extends over practically the whole of Eastern Asia, so that India, China and Japan, the greatest rice-growing countries in the World, are all intimately concerned in this question.

One thing that we want to know more about is the various wild grasses which may serve as alternative foodplants. Some work on this line has been done in Bombay and around Poona ; the following wild grasses have been found to be natural food plants : Job's Tears, *Ischæmum striatum*, *Andropogon orderatus* and *Antistheria ciliata*. If any of you have any opportunity of observing other natural foodplants, such information will be useful. It will be useful directly for control, for if we find that *Schœnobius* is breeding in wild grasses on *bunds* or other places around paddy-fields, we can attack it by control of such wild grasses on adjacent areas ; and incidentally this measure will also be effective against *Leptocorisa*.

There is also a possibility of control of this pest by the use of its natural parasites, but this again is a subject which requires detailed investigation. The egg-masses are sometimes parasitized but at present we do not know what parasites are concerned or to what extent or in what areas they occur. Investigation may show that effective parasites may occur in some localities within the area of distribution of *Schœnobius* (not necessarily in India) and we may be able to utilize these.

But work of this sort requires very careful preliminary investigation. We should not want, for example, to bring in hyper-parasites which might attack parasites already present and doing good work. Then again there is a probability of finding parasites preying on the larvæ, but these are fairly well protected inside the stems of the foodplant so that larval parasites are likely to be less effective than egg-parasites. I must confess that I am a little doubtful whether we shall be able to find any effective parasites. As I said just now, *Schœnobius bipunctifer* has a wide range over practically the whole of South-Eastern Asia and is known to occur throughout India, Burma, Ceylon, China, Formosa, Borneo, Singapore, Java and Sumatra, so that its area of distribution is pretty continuous and we may assume that it is a truly endemic species which has existed for a very long interval of time, probably for several hundreds of thousands of years, throughout that area of distribution. Its natural foodplants, wild grasses, are universally distributed and its own distribution has apparently only been limited by the desert areas on the North-West, by the colder climate of the Palæarctic Region to the North, by the Indian Ocean to the South and West, and probably by natural barriers to the South-East. It is a species which is frequently met with at sea some distance from land, probably carried by off-shore winds, as I myself noticed when employed in a Surveying Ship off the coast of Ceylon, and at a Meeting of the Entomological Society of London, at which I was present in June 1909, there were exhibited several specimens which had been captured at sea nearly two hundred miles off the coast of Cochin China, from which they had apparently been carried by the wind. [See "Proceedings of the Entomological Society of London," 1909, p. xxxix.] I see no reason why the egg-masses, when laid on grasses, should not be transported equally well and carry any egg-parasites with them. I have already dealt elsewhere [" Proceedings of the Entomological Society, 1909, p. xiv ; " Transactions of the Linnean Society, Zool. XIII, 320] with the distribution of insects by the action of cyclonic storms in conjunction with the movements of the upper strata of the atmosphere, so I need not go into that again. But I mention these facts, firstly, to show you that if any effective parasites of *Schœnobius* do occur anywhere they are likely to have been distributed already by natural causes and, secondly, to impress upon you the necessity of looking on this sort of problem in as broad a way as possible. It is by the accumulation of scattered facts, each perhaps insignificant in itself but gathered from as wide a field as possible, that our knowledge is advanced, and I think that such advance will be expedited by the centralization of our facts as much as possible. If, therefore, any of you Provincial workers come across any egg or other parasites of *Schœ-*

nobius, it will help us and others if you will send us in ample material, living if possible, for study and experiment.

Schœnobius immeritalis has been reared at Trivandrum in Travancore, from larvæ boring in rice-plants. This species does not seem to have been bred otherwise but it is widely distributed and may prove to be a minor pest of paddy.

Scirpophaga gilviberbis also is not definitely known to be a paddy-pest, but it is found very commonly in paddy areas in Lower Burma and is likely to prove to be a borer in paddy stems.

Chilo simplex occurs as a stem-borer in paddy but is usually rather a minor pest of the rice-plant and we shall come to it again under *juar*.

Chilo simplex is noticed in rice-plants at Pusa only when the crop is maturing. The dry ears are conspicuous and such plants contain several young borers, as many as ten to fifteen.

Sesamia inferens is also found in rice-plants as a stem-borer but is usually a minor pest.

Sesamia larvæ are found in large numbers late in the season (*i.e.*, just before and in early winter); they are also found in large numbers in the stubble after the crop is harvested. As regards control, burning of the stubble is an essential step against this, as well as against *Chilo* and *Schœnobius*.

A few insects attack the roots of rice-plants and this group of pests will doubtless be extended considerably in the future.

Phyllognathus dionysius.

Anomala polita.

Conosia irrorata.

Phyllognathus dionysius is described and figured in Entomological Memoirs, Vol. II, pp. 139-143, tab. 13, from specimens sent from Belgaum as injuring roots of young paddy plants in areas of black soil. We also have a record of the adult cutting stems of young paddy in South Kanara on one occasion. The insect is widely distributed and the Pusa Collection contains examples from South Kanara, Coimbatore, Belgaum, Igatpuri, Hoshangabad, Seoni, Pusa, Chapra, Dehra Dun and Simla. It does not seem to be a pest as a rule, or perhaps it would be more correct to say that we do not know it as a pest.

Anomala polita is probably the species referred to as *A. varians* in Entomological Memoirs, Vol. II, pp. 143-146, tab. 14, the name *varians*, as generally used hitherto, including two species, *A. polita* and *A. bengalensis* [see Entomological Note 12]. The larvæ may occur commonly at roots of rice in dry areas, but we know very little about them.

Conosia irrorata is a Tipulid found commonly in rice areas in India and Burma. We know nothing of its life-history but it seems likely that the larva will be found to feed on roots of paddy.

The sucking insects on paddy include :—

Menida histrio.
Tetroda histeroides.
Leptocorisa varicornis.
Nephotettix bipunctatus.
,, *apicalis.*
Tettigoniella spectra.
Kolla mimica.
Sogata pusana.
,, *pallescens.*
,, *distincta.*
Liburnia sp. ?
Ripersia sacchari oryzæ.

Menida histrio [" South Indian Insects ", pp. 474-475, fig. 354] has been recorded as a minor pest of paddy in Southern India. It is probably unimportant as a pest and may be collected in hand-nets, if required.

Tetroda histeroides [" South Indian Insects ", p. 477, fig. 359] has been recorded from Salem and Coimbatore as an occasional minor pest of paddy, but also seems of little importance. It is widely distributed in India.

Leptocorisa varicornis [" South Indian Insects ", pp. 479-480, fig. 363] seems to be the common pest of rice, so far as I can make out. Distant describes three species of *Leptocorisa* in his *Fauna* volume but I have been quite unable to make out more than one species from our series from India and Burma. Its life-history and occurrence have been described at length in Entomological Memoirs, Vol. II, pp. 1-13, tab. 1, and there does not seem to be much to add to that.

As regards control, the keeping of *bunds* and other areas adjacent to paddy-fields clear of wild grasses will reduce the numbers of this insect and, when it does occur in paddy-fields, the use of hand-nets will keep it under control. When I was at Coimbatore, we made comparative trials of the efficiency of hand-nets and bag-nets against this insect, and found that the hand-nets gave much better results.

M. Ghosh. With regard to *Leptocorisa varicornis,* I was informed by a gentleman, residing in Burdwan, Bengal, that he had a sad experience of the damage done by this bug. In Burdwan district, Raniganj Sub-division, there is no *aus* paddy cultivated, but he wanted to try it. The local cultivators tried to dissuade him, saying that *aus* paddy was never

a success in the locality as it was always very badly attacked by *Leptocorisa*. However, he put down eight acres under *aus* paddy and the plants grew well but, as the cultivators had predicted, when the crop came into ear and milk was forming in the grains, swarms of *Leptocorisa* came and attacked the whole crop. He tried his utmost to save it, and kept fires burning the whole night at several places in the midst of the crop, and produced smoke in portable vessels which were carried through the crop and the smoke fanned over the ears. He observed large numbers of bugs to be attracted to the fires and burnt. He used about 44 gallons of kerosine oil and several cartloads of cowdung cakes; but all to no purpose. All the grains were sucked out and he got only the straw, which however the cattle would not eat on account of its buggy smell. He had to throw the straw into the manure pit.

Leptocorisa is a very bad pest on the West Coast of Madras. On the Farm at Coimbatore hand-nets have been found very useful. In the interior districts, in some places, a long bamboo with a mat curved in the form of a nest is used by the *ryots*; this is a sort of a crude hand-net.

Nephotettix bipunctatus was included in "South Indian Insects", p. 497, fig. 386, as a probable pest of paddy on account of the enormous numbers in which it sometimes appears in rice areas. Since that was written, it has appeared as a pest in the Central Provinces and we have heard a good deal about it in the last two years. Mr. Misra visited the attacked areas and wrote a note which has been published. We endeavoured to breed this species at Pusa in 1915 without success but were able to rear it last year. Perhaps Mr. Ratiram will tell us about the outbreak in the Central Provinces.

Nephotettix bipunctatus is a serious pest of paddy in the Central Provinces. It has come into prominence only since 1913. It occurs throughout the year. Adults are found on the fresh shoots given out by the stubble after harvest. In summer they are found on the grasses round about the tanks. Twelve varieties of grasses have been observed to serve as foodplants for this insect.

In order to control it, in the beginning hand-nets and light traps were made in large numbers and distributed to the cultivators through the *tahsildars*; but it was found that the hand-nets were too small for the purpose, and the lamps became smoky and became dark after only about half an hour of having been lighted. So both these measures were discarded, and large bags replaced the hand-nets. When a rope or bag-net is used, the bugs fall into the water, but all of them do not die—they get on to the plants again. In order to find out the quantity of kerosine which would require to be present in the water to ensure the

death of the bugs, a series of experiments was carried out in the Laboratory. First one part of kerosine was taken to one part of water and this was gradually diluted until there was one part of kerosine present in 108 parts of water. It was found that a proportion of one part of kerosine in eighty parts of water was effective, but that mixtures of higher dilution were ineffective.

Last year (1916), in July only one field was very badly affected. The surrounding fields, although having the same variety of rice, were practically immune.

Mr. Fletcher. This insect seems to have appeared as a pest in the Central Provinces quite sporadically. It was very bad in 1914 and 1915 but scarcely appeared in 1916 and it is probable that we shall not hear much of it again for some years there. But it is evidently liable to appear as a pest in other rice-areas.

Nephotettix apicalis usually occurs with *N. bipunctatus*, although usually in less numbers, and may also be a pest, but we have no record of it as doing damage by itself. Both these two species form a large proportion of the "Green-fly nuisance" that one hears so much about in Calcutta at the end of the rainy season.

Tettigoniella spectra ["South Indian Insects," pp. 496-497, fig. 385] is also common in paddy areas and is probably a minor pest of paddy. It has been reared at Pusa on sugarcane and on a wild grass.

Kolla mimica is another small bug, very like *Tettigoniella spectra*, which was reared on paddy at Pusa when attempts were being made in 1915 to breed out *Nephotettix*. A coloured plate showing the life-history was done [*exhibited*]; as a matter of fact, it was started with the idea that we were dealing with *Nephotettix* when the rearing was commenced from bundles of eggs found thrust into the leaf-tissue. It is not a regular pest of paddy, so far as we know.

Sogata pusana, *S. pallescens* and *S. distincta* are also small bugs found in some numbers on paddy when *Nephotettix* was being investigated.

A species of *Liburnia* is said to occur on paddy and to have done serious damage in Bengal about nine years ago, but exactly what it is and whether it is a *Liburnia* seem doubtful.

Ripersia sacchari oryzæ is referred to under the name *R. sacchari* in Entomological Memoirs, Vol. II, pp. 128-129, tab. 12, figs. 10-13. On that occasion this insect occurred in 1907 widely on rice throughout Tirhut and Bihar. The insect has since been named by Mr. E. Ernest Green as *Ripersia sacchari* var. *oryzæ*. Whether it is truly distinct from the form on cane, we do not know, but the rice form seems to be widely distributed in India.

In 1907 it was reported from Bankipur, where it is known as *Chatra*. The diseased condition due to it was ascribed to drought by the cultivators.

Ripersia was noticed in patches in an experimental plot of rice on the Government Farm. The affected patches had a scorched appearance.

The flowers of the rice-plant are attacked by Cetoniad and Meloid beetles. *Chiloloba acuta* has been reported from Cuttack, Nagpur, and Virajpet (Coorg) and is often common in rice-fields. *Lytta tenuicollis* has also been found at Hagari (Bellary) and Bhandara (Central Provinces), and doubtless other species occur in other localities. They can be collected by hand or in hand-nets.

Are there any more pests of paddy?

In the Central Provinces a fly maggot was observed mining the leaves. A similar maggot is found mining *dubh* grass (*Cynodon dactylon*) leaves.

Such fly-maggots are found occasionally at Pusa mining the apical parts of the leaves, but this insect is not a pest.

JUAR (*Andropogon Sorghum*).

Andropogon Sorghum, commonly called *juar* in Northern India, *cholam* in Madras, is another very important crop in India and has also a large number of insect pests, although many of these have already been dealt with under sugarcane, paddy, and other crops.

The seedlings are attacked by an Anthomyiad fly referred to in "South Indian Insects," pp. 356-357, fig. 215, as the "Cholam Fly." Mr. Ballard did some work on these flies and came to the conclusion that there are at least three species (1) the Cholam Fly, which does not breed in rotten fruit, but which is found in *cholam*, wheat, *varagu* (*Paspalum scrobiculatum*), *Panicum frumentaceum*, maize and broom corn (a kind of *cholam*); (2) the Cumbu Fly, which is very closely related to the Cholam Fly, but apparently distinct, and which feeds on *cumbu* and *Panicum miliaceum*; (3) the Tomato Fly, which breeds in rotting fruits and vegetable matter generally. I may add that Mr. Ballard informed me that the figure of the adult fly shown in my book, fig. 215, No. 4, is probably the female of the Tomato Fly. If Mr. Ballard returns to India, I hope that he will continue his investigations on this subject.

The larva of the true Cholam Fly bores in the young stem of the foodplant, which may be *cholam* or any other of the plants I have just named, and causes a characteristic "deadheart," and may be a serious pest of young seedlings. The only control-measures seem to be increasing the seedrate to allow for vacancies and prompt removal and destruction of the young plants seen to be attacked.

Mr. Ramachandra Rao. In "Insect Life," p. 639, Mr. Howlett stated that one species of Cordylurid fly, which he called Rice Stem-fly, has been bred from rice, *Sorghum*, maize, millets, *Panicum miliaceum*, *P. frumentaceum*, celery, *Cucumis sativus*, and brinjal. But these flies were studied at Coimbatore and it was found that there are at least three distinct species, which were separated up by Mr. Ballard, as Mr. Fletcher has just told us.

Mr. Fletcher. We will go on to the leaf-eating insects found on *juar* and will take the caterpillars first :—

Amsacta albistriga and *A. moorei*.
Cirphis unipuncta.
,, *loreyi*.
Spodoptera mauritia.
Prodenia litura.
Pelamia (Remigia) frugalis.
Dasychira securis.
Melanitis ismene.
Chapra mathias.
Marasmia trapezalis.

Amsacta albistriga and *A. moorei* occur in Southern India, especially in the Salem and South Arcot districts of Madras and in Mysore, as serious and destructive pests of *cholam*. We have already considered these species and need not go over the same ground again, unless anyone has anything to add.

Cirphis unipuncta has also been taken under paddy. It is distributed throughout India and Burma and is a serious pest of *juar* in most localities.

Cirphis loreyi occurs throughout India and is probably of some importance as a pest, but often confused with *C. unipuncta*. It has been found on *juar* at Coimbatore and Poona. We considered this also under paddy and control will be the same as for *unipuncta*.

Spodoptera mauritia has been recorded on *juar* at Nagpur and probably occurs in most districts at times, but it is not usually serious on *juar*. We considered this also under paddy.

Prodenia litura is a very polyphagous species which has been found on *juar* at Poona. It is not a regular pest of *juar*.

Pelamia (Remigia) frugalis ["South Indian Insects," pp. 388-389, fig. 253] occurs abundantly throughout India, Burma and Ceylon, the larva feeding on wild grasses as a rule. Occasionally it is found on cultivated Gramineæ and has been noted on *juar* at Nagpur, but it is not a pest of regular occurrence.

Dasychira securis has already been taken under sugarcane and paddy. It occurs fairly commonly on *juar* but is scarcely a pest.

Melanitis ismene and *Chapra mathias* have also been considered under paddy. They are both found, *M. ismene* the more commonly, on *juar*, but not as pests.

Marasmia trapezalis ("South Indian Insects," pp. 432-433, tab. 33] occurs throughout India, Burma and Ceylon, the larva rolling and feeding on the leaves of *juar* and other Gramineæ. We have it recorded on *juar* from Pusa and Nagpur, but it probably occurs everywhere that this crop is grown. It is a minor pest on *juar* as a rule, rarely serious. The picking of the rolled leaves is the only practical means of control.

The beetles feeding on *juar* include :—

Phidodonta modesta ?
Pachnephorus impressus.
,, *bretinghami.*
Tanymecus indicus.
Myllocerus blandus.
,, *11-pustulatus.*

Phidodonta modesta—or, at least, the Hispine found on sugarcane at Pusa and which has been considered as this species, although there is considerable doubt about its identity—has also been found on *juar* at Pusa, but it is not a pest.

Pachnephorus impressus and *P. bretinghami* are found on young shoots which they nibble as in the case of sugarcane. The larvæ also live in the soil at the roots of the plants and probably do some damage.

Tanymecus indicus has been found on *juar* at Pusa and probably occurs throughout Northern India, especially on young shoots.

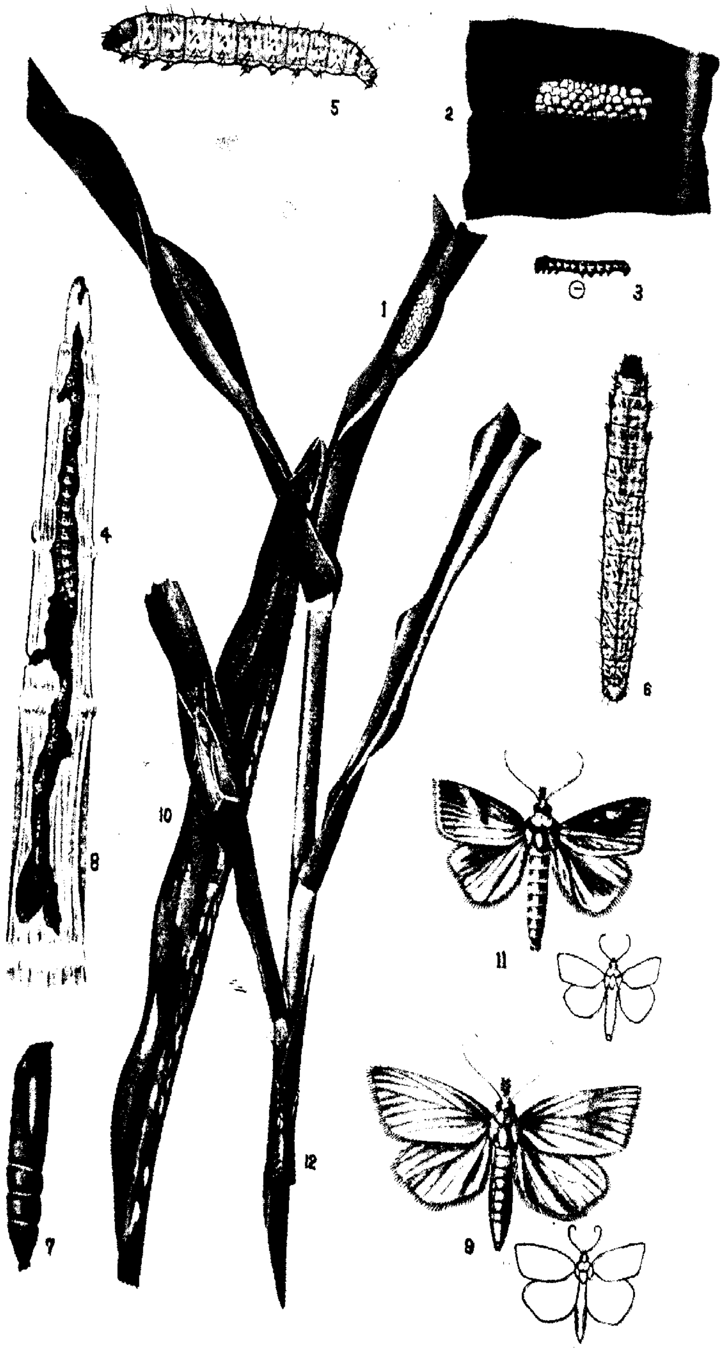
Myllocerus blandus and *M. 11-pustulatus* are both very general feeders and sometimes occur on young shoots in some numbers.

Next, we have the grasshopper pests of *juar.*

Epacromia tamulus.
Orthacris sp.
Colemania sphenarioides.
Chrotogonus spp.
Hieroglyphus banian.
,, *nigro-repletus.*
Oxya velox.

Epacromia tamulus (*dorsalis*) ["South Indian Insects," pp. 525-526, fig. 417] is generally common on *juar* in most districts and is often a pest. It may be caught in bag-nets or hand-nets and is also attracted in some numbers to lights at night.

In Gujarat *Epacromia tamulus* attacks *juar* in November and December. Bagging was tried against this but was not successful. During the



CHILO SIMPLEX.

Chilo simplex, Butl.

The plate shows a young maize plant on which eggs were laid and the young caterpillars bored down into the plant through the heart-leaf. One-half of the blade of the heart-leaf was destroyed and the leaf broke down when it issued out of the plant.

Figs. 1 and 2 show eggmasses on leaf (natural size and magnified);

Fig. 3, a young larva (much enlarged);

Figs. 4, 5 and 6, the grown-up larvæ, the first inside the affected stem and the other two drawn enlarged.

Figs. 7 and 8, show pupæ, inside the stem and enlarged;

Figs. 9, 10, 11 and 12, show the moths in resting and flying attitudes.

Figures in outline show the natural sizes.

monsoon months (July-September), light traps, which had been put out for *Amsacta*, attracted *Epacromia* in large numbers.

At Coimbatore *Epacromia tamulus* is found to be serious on *cholam* during November and December. **Mr. Ramakrishna Ayyar.**

Orthacris sp. [" South Indian Insects," p. 527, fig. 420] is a wingless grasshopper found commonly on *cholam* in Coimbatore, Tinnevelly and Bellary, and probably throughout the Plains of Southern India. It may be a minor pest at times, but is scarcely a pest as a rule. **Mr. Fletcher.**

Colemania sphenarioides [" South Indian Insects," pp. 527-528, tab. 48] has apparently a curious limited distribution in Mysore and the Bellary and Kurnul Districts of Madras. A good deal of work has been done on this species, which is a very serious pest in the districts mentioned, and there is not much to add to that, I think, except that in the last three or four years this insect seems to have become less abundant. Why this is so we do not know exactly. Probably it is due to control by natural enemies. Anyway, it is an insect which requires watching in case it should become abundant again or spread to other districts.

Chrotogonus spp.—how many species we have in India or what are the differences between them I cannot pretend to say, and the issue of Mr. Kirby's volume in the *Fauna* series does not seem to help us much —attack *juar*, especially young plants, as they do so many other crops. Control by bag-nets seems the simplest plan.

Hieroglyphus banian has already been considered under sugarcane and paddy and occurs sometimes on *juar* but does not seem to be a regular pest of this crop.

Hieroglyphus nigro-repletus [" South Indian Insects," pp. 531-533, fig. 425] is a short-winged grasshopper found on *cholam* in Bellary, Kurnul and Guntur. It is a minor pest, not occurring in large numbers as a rule.

Oxya velox ["South Indian Insects," p. 533, fig. 426] is common on *juar* in most districts and the eggs are often laid on the bases of *juar* stalks. We have already considered this insect under paddy.

The next group of insects includes those caterpillars found boring in the stem :—

Chilo simplex.
Diatræa spp.
Papua depressella.
Sesamia inferens.

Chilo simplex is probably the worst pest of *juar* in India and is common, usually abundant, in all areas under *juar*. The species is briefly described and figured in " South Indian Insects," pp. 422-424, figs. 299, 300, and

we have since issued a coloured plate showing the life-history. The eggs are laid in a mass on leaves and the larvæ burrow in the stem. Sometimes practically every plant in a field may be bored, often by many larvæ. As regards control, the collection of egg-masses and destruction of affected plants are not practicable measures on a field-scale. Destruction of stubble, promptly after harvest, may prove effective but, before advocating this, we require further investigation of the species—whether the larvæ in the stubble carry over parasites and so on. Another point concerns the use of the *juar* stalks as fodder ; we require to know how long these stalks are capable of containing *Chilo* in any stage and, if there is danger from this source, whether any other method of storage of this fodder can be used. As I pointed out in my opening address, *Chilo* is one of the insects which we have found is capable, at Pusa, of continuing in a resting condition and emerging at irregular intervals over a comparatively long period of time. But such conditions will probably vary locally.

As regards parasites, an undescribed species of *Trichogramma* attacks the eggs and is fairly common, the attacked eggs turning black. *Xanthopimpla punctata* and *Tarytia flavo-orbitalis* are also recorded by Morley [*Fauna of India, Hymenoptera*, Vol. III, pp. 125, 507] as bred from *Chilo simplex* but it is uncertain whether the host was really *Chilo* or *Diatræa*.

In Bombay *Chilo simplex* is abundant in *juar*.

And in the Central Provinces also.

The species of *Diatræa* have already been dealt with under sugarcane. So far as we can make out at present, the species of *Diatræa* are the common borers in cane, occurring uncommonly in *juar* and maize, whilst *Chilo simplex* is the common borer in *juar* and maize and occurs occasionally in cane. *Diatræa* does not seem to be common in *juar* and is probably of small importance as a pest of this crop.

Papua depressella has been reared from *juar* at Lyallpur but is a mere casual visitor in this crop.

Sesamia inferens occurs throughout India and is usually a minor pest of *juar*. The larvæ are often found in large numbers in the stubble and may be destroyed there.

The flower-heads of *juar* are attacked by several Cetoniad and Meloid beetles. A long list of these insects could be prepared but we need only consider a few common ones and those of which we have records are :—

Heterorrhina elegans, *Anthracophora atromaculata*, and *Protætia alboguttata*, all found in small numbers at Coimbatore ; *Anatona stillata* ["South Indian Insects," p. 282, fig. 122] at Bellary and Bangalore ; *Oxycetonia versicolor* [*l.c.* p. 284, fig. 123] in Southern India ; *Chiloloba*

acuta [*l.c.*, p. 284, fig. 124] in South India and Nagpur ; *Lytta tenuicollis* [*l.c.*, p. 303, fig. 148] in South India and Surat. Most of these beetles not only devour the pollen but also bore into and feed on the young grains, and may do considerable damage in local areas. They may be collected by hand or in hand-nets.

These beetles lead us on to the group of insects which especially attack the ear-heads of *juar*. Of these we know :—

Stenachroia elongella.
Sitotroga cerealella.
Cecidomyiad Flies.

Stenachroia elongella [" South Indian Insects," p. 421, fig. 296] has been recorded in Madras from larvæ found on *cholam* ear-heads at Coimbatore and Hagari (Bellary), and at Pusa from larvæ on *juar* ear-heads and stems, maize cobs and *marua* ear-heads. The caterpillar webs over the ear-heads, in which it feeds, and is a sporadic pest of *juar* in Madras and Bihar, but apparently is not known in Western or Northern India.

Mr. Shroff. It probably occurs in Burma also, but I cannot say definitely whether it is this species.

Mr. Fletcher. *Sitotroga cerealella* [" South Indian Insects," p. 456, fig. 331] occurs throughout India, Burma and Ceylon as a pest of stored grains. It also occurs in the field on ripe ears of *juar*, paddy, etc., and, though hardly a pest in the field, it may thus be brought into stores with the grain, and we must therefore not overlook its occurrence on the plants in the field.

The Cecidomyiad Flies occurring in *juar* heads have not yet been identified and perhaps more than one species may be concerned. In Madras a Cecidomyiad, found hitherto at Coimbatore and Udumalpet, attacks *cholam*, the egg being thrust in under the glumes when the seeds are about half-ripe and the larva boring in the seeds of the plants in the field, so that the damage done may be considerable. In Bombay there is a Cecidomyiad on *juar* which is probably distinct from the species found in Madras. Anyway, its habits are different, as in the Bombay Cecidomyiad the flowers are attacked and the grain is not developed. For the sake of convenience, pending proper identification, we may call the Madras insect the "*Cholam* Cecidomyiad" and the Bombay insect the "*Juar* Cecidomyiad." We lately received some specimens of the latter insect from Poona, collected in December 1906, and it appears that the ovary of the *juar* flower is destroyed by the Cecidomyiad grub, which pupates inside, the result being that no grain is developed. These Poona specimens were extensively parasitized by a Chalcidid.

The Cecidomyiadæ is a family of which very little is known in India as yet, at least as regards their capabilities as crop-pests. The species

are very small and easily overlooked but it is probable that we shall find a good many pests in this group as time goes on.

The next group of insects found on *juar* includes those found sucking the juices of the plant. On my list I have :—

Dolycoris indicus.
Agonoscelis nubila.
Nezara viridula.
Piezodorus rubrofasciatus.
Menida histrio.
Anoplocnemis phasiana.
Leptocorisa varicornis.
Lygæus pandurus.
Calocoris angustatus.
Megacœlum stramineum.
Phenice mœsta.
Pyrilla perpusilla.
,, *aberrans.*
Pundaluoya simplicia.
Aphis adusta.
Mites.

Dolycoris indicus ["South Indian Insects," p. 470, fig. 347], *Agonoscelis nubila* [*l.c.*, p. 472, fig. 351], *Nezara viridula* [*l.c.*, p. 473, fig. 352], *Piezodorus rubrofasciatus* [*l.c.*, p. 474, fig. 353], *Menida histrio* [*l.c.*, p. 474, fig. 354] are all Pentatomid bugs, found more or less commonly on *juar*, but scarcely pests as a rule. When doing damage, they may be collected in hand-nets.

Anoplocnemis phasiana [*l.c.*, p. 477, fig. 360] has been found on *cholam* in Madras, but is not common on this crop.

Leptocorisa varicornis [*l.c.*, p. 479, fig. 363] has been considered under paddy. It is sometimes found on *cholam*, sucking the tender seeds, but is scarcely a pest as a rule.

Lygæus pandurus [*l.c.*, p. 481, fig. 365] is found commonly on *juar* at times but is not known to be a pest.

Calocoris angustatus [*l.c.*, p. 490, fig. 376] occurs in Madras as a pest of *cholam*. It has recently been dealt with by Mr. Ballard, in Bulletin No. 58, and there seems to be no more to add at present. It is apparently only known in Southern India.

Megacœlum stramineum is another Capsid, more widely distributed than *Calocoris*, and doing similar damage to *juar*. Other undetermined Capsids also occur, but we know little about them.

Phenice mœsta [*l.c.*, p. 493, fig. 380] occasionally occurs on *juar* in some numbers, but does no damage so far as we know.

Pyrilla perpusilla [*l.c.*, p. 494, fig. 381] sometimes occurs on *juar* in some numbers but is rarely of any great importance on this crop. It is found chiefly in Southern India.

Pyrilla aberrans occurs in Central and Northern India on *juar* much in the same way as *perpusilla*. It is fully dealt with in a Memoir by Mr. Misra, now in the press, so I need not say any more about it now.

Pundaluoya simplicia [*l.c.*, p. 494, fig. 382] is an important pest of *cholam* especially in Madras. It occurs probably all over India, although we have few records, and is very widely distributed outside of India also, being known from South Nigeria, the Seychelles and Hawaii. It is probably identical with *maidis*, Ashmead, described from the Southern United States and is also perhaps the same as *Liburnia psylloides*, Leth. [*Indian Museum Notes*, III, 105, fig.]. The life-history is briefly described in "South Indian Insects" and, as noted there, the attack is usually localized in patches, the attacked plants assuming an unhealthy yellow appearance. The drain of plant-juice, when this insect is present in numbers, must be very great and the result is that practically no grain is formed when the attack is bad.

As regards control, as I have said already in my book, this is very difficult, as the insects live protected inside leaf-sheaths. It is therefore practically impossible to get at them. They are usually attended by ants and one line of attack might deal with these ants' nests. Beyond that, I can suggest nothing beyond cutting the affected plants for use as green fodder. These plants are usually conspicuous and localized and in any case will not produce much in the way of grain, so their removal is indicated.

Mr. Ramakrishna Ayyar. *Pundaluoya* is very serious on *cholam* at Coimbatore. The bug is found in all its stages on the affected plants. The attack resembles an Aphid attack in its effects but these are more serious.

Mr. Khare. At Nagpur *Pundaluoya simplicia* occurred in one year in the Botanical area.

Mr. Ghosh. At Pusa *Pundaluoya simplicia* occurs on *juar* every year but has never been found doing serious damage.

Mr. Fletcher. An Aphid, supposed to be *Aphis adusta*, occurs on *juar*, usually on individual plants which may be covered with this Aphid; but whole areas as such do not seem to be affected. So we cannot consider this as a very serious pest.

A Mite, or perhaps Mites of more than one species, occurs abundantly on *juar* in Madras and may do considerable damage. It is preyed on by a minute Coccinellid which devotes its attention to devouring the Mite's eggs and so checking its increase. Practically all the leaves in a

field of *juar* may be covered with this Mite and control on a field scale seems rather out of the question.

The roots of *juar* are attacked by a subterranean Aphid which has been found at Poona and is probably widely distributed, but we seem to know very little about it.

On the Coimbatore Farm Cockchafer grubs were noticed to do a good deal of damage to roots of *cholam* plants in 1916.

BAJRA (*Pennisetum typhoideum*).

[*Cumbu*—Madras.]

The pests of *bajra* are very similar to those of *juar* so it will not take us long to run through the list.

Bajra seedlings are attacked by :—

Chrotogonus spp.
Epacromia tamulus.
Tanymecus indicus.
Anthomyiad Fly.

Chrotogonus spp., *Epacromia tamulus* and *Tanymecus indicus* attack young *bajra* plants in the same way as they do other young plants and there is nothing special to say about them as regards *bajra*.

The Anthomyiad Fly attacking *cumbu* seedlings has been noticed in Madras and separated by Mr. Ballard as a species distinct from the *cholam* stem-fly. Its larva in *cumbu* bores both in young and old plants, in the stem and (characteristically) in the ear-head, in which it bores in corkscrew fashion. So far, this fly seems to be known only from Madras, but is probably widely distributed in India. Control should be as in *cholam* stem-fly.

The insects found eating the leaves of *bajra* include :—

Flea Beetles.
Colemania sphenarioides.
Orthacris sp.
Estigmene lactinea.
Amsacta moorei.
,, *albistriga.*
Marasmia trapezalis.
Episomus lacerta.
Myllocerus 11-pustulatus.

Flea-beetles are sometimes found in some numbers on *bajra*-leaves, but it is impossible at present to identify these beetles. Probably many

species occur as pests, on this and other crops, but we know very little about them.

Colemania sphenarioides and *Orthacris* sp. have already been dealt with under *cholam* and there is no more to add. *Cumbu* is a favourite foodplant of *Colemania*, largely because it is grown to a considerable extent in the area of occurrence of this grasshopper.

Estigmene lactinea [" South Indian Insects," p. 368, fig. 230] is sometimes found on *cumbu*, principally in Madras, but is sporadic and scarcely a pest as a rule.

Amsacta moorei and *A. albistriga* have already been dealt with several times. Both occur as pests of *cumbu* in Madras.

Mr. Jhaveri. *A. moorei* also attacks *bajri* in North Gujarat.

Mr. Fletcher. *Marasmia trapezalis* [" South Indian Insects," pp. 432-433, tab. 33] rolls the leaves of *bajra* but is a minor pest as a rule.

Episomus lacerta has been recorded from Surat and *Myllocerus 11-pustulatus* is generally distributed; both may be found on *bajra* at times, but neither is of any great importance as a pest.

The next group of pests of *bajra* includes those insects found boring in the stem :—

Chilo simplex.
Sesamia inferens.

Chilo simplex is a common borer in the stem but of less importance than in *juar* or maize.

Sesamia inferens is often common also, but of rather minor importance as a rule in this crop.

At the roots we get Termites and *Anomala* grubs but both these have been considered under sugarcane and there is no more to add as regards *bajra*.

The sucking insects found on *bajra* include :—

Calocoris angustatus.
Megacœlum stramineum.
Aphid.
Nezara viridula.

Calocoris angustatus and *Megacœlum stramineum* have been dealt with under *juar*. Both occur on *cumbu* and do considerable damage, and other Capsids may also occur.

An Aphid is found on *bajra* in much the same way as on *juar* but we are not certain of its identity.

Nezara viridula and other Pentatomid bugs also occur on *bajra* but are of minor importance.

The flowers and heads of *bajra* are attacked by :—

Anatona stillata.
Chiloloba acuta.
Idgia cardoni.
Lytta tenuicollis.
Cumbu Cecidomyiad.
Heliothis obsoleta.

Anatona stillata [" South Indian Insects," p. 282, fig. 122] is recorded from Hadagalli (Bellary District), Bangalore and Poona, and is a local pest of some importance, the beetles devouring the pollen and unripe grains. The beetles may be collected in hand-nets.

Chiloloba acuta [*l.c.*, p. 284, fig. 124] occurs in most parts of India and occurs on the heads in the same way as *Anatona stillata*. It has been recorded from Madras to the Punjab.

Idgia cardoni (Melyrinæ) has been reported on *bajra* flowers in the Punjab but does not seem to have occurred in recent years and is probably not a pest as a rule.

Lytta tenuicollis [" South Indian Insects," p. 303, fig. 148] occurs in South India and Bombay principally, on *bajra* heads, which are damaged by the adult beetles feeding on the pollen and young grain. It has been reported from several parts of Madras and from Surat.

At Nadiad Blister Beetles are serious at times when the *bajri* plants are in flower.

In Madras a Cecidomyiad fly has been found on *cumbu* at Coimbatore and Mettupalaiyam. The larva bores in the seeds of the plants in the field, the eggs being laid only at night. During the daytime the flies hide away among the sheathing leaves at ground-level. The damage done may be very considerable. This *Cumbu* Cecidomyiad is unlikely to be confined to the Coimbatore District and will probably be discovered to be widely spread in India if search is made.

Heliothis obsoleta has been bred at Pusa from larvæ found in *bajra* heads, in which it is occasionally found boring, but it has not been noticed as a real pest.

MAIZE (*Zea mays*).

Maize is another important food-crop, especially in Northern India, and has a long list of insect pests, but many of these are identical with those already discussed under sugarcane, paddy, *juar* and *bajra* so that we need only mention these briefly.

Maize seedlings are attacked by the Anthomyiad Fly found in *cholam* seedlings. The species of fly, damage done and control methods are all identical.

Eating the leaves of maize we get :—

Cirphis unipuncta.
,, *loreyi.*
Prodenia litura.
Laphygma exigua.
Amsacta moorei.
Estigmene lactinea.
Marasmia trapezalis.
Anomala antiqua.
Heterorrhina micans.
Monolepta signata.
Tanymecus circumdatus.
,, *indicus.*
,, *hispidus.*
Myllocerus 11-pustulatus.
,, *blandus.*
Oxya velox.
Hieroglyphus banian.
Epacromia tamulus.
Chrotogonus spp.

Cirphis unipuncta is common on maize, sporadically serious. We have already considered this species under paddy. In the case of maize the caterpillars are often found in the tube formed by the leaf-sheaths and may be dealt with by dropping kerosinized dust or ashes into this tube.

Cirphis loreyi has been noted on maize at Pusa and Surat and is doubtless common throughout India. Control as in *C. unipuncta.*

Prodenia litura has been recorded on maize at Daltonganj but is doubtless found on maize occasionally in most districts. It is scarcely a pest of maize.

Laphygma exigua is found especially on youngl eaves and shoots and sometimes occurs in numbers. The damage done is much like that caused by *Cirphis.*

Amsacta moorei is a pest of maize in those districts in which this insect does damage to crops generally.

Mr. Jhaveri. In Bombay *Amsacta moorei* is sporadically bad on maize in the Panchmahal District.

Mr. Fletcher. *Estigmene lactinea* is sometimes found on maize in small numbers but is a minor pest as a rule.

Mr. Ratiram. In the Central Provinces *E. lactinea* is a minor pest of maize but is not bad.

Marasmia trapezalis [" South Indian Insects," pp. 432-433, tab. 33] occurs commonly on maize, the larva rolling the leaves. It is a minor pest as a rule.

Marasmia trapezalis occurs throughout the United Provinces, but does not do much damage. On the Experimental Farms it is hand-picked.

Anomala antiqua has been reported on maize at Tatkon, in Burma, but I do not know how far this is a pest.

In one year it was found in large numbers at Tatkon.

Heterorrhina micans has been reported on maize at Taliparamba, in Malabar, but is not a pest.

Monolepta signata occurs on maize, as on so many other crops, but is scarcely a pest.

Tanymecus circumdatus [*Fauna of India, Curculionidæ*, Vol. I, pp. 90-91, fig. 24*a*] occurs throughout Burma and India, except Madras and Bombay, and has been found on maize at Cuttack and Lahore. It is scarcely a pest.

Tanymecus indicus [*l.c.*, pp. 99-100, fig. 32] has been noted on maize at Pusa but is doubtless common throughout Northern India. It may at times do damage by nibbling young seedlings or tender leaves, but we do not usually regard it as a pest.

'*Tanymecus hispidus* [*l.c.*, p. 98] has been noticed in the Pusa District attacking maize, and doing a little damage sporadically, but it is not a pest as a rule.

Myllocerus 11-pustulatus [*l.c.*, pp. 350-352] has been recorded on maize at Surat and Pusa and is doubtless to be found commonly on maize throughout India, but it is scarcely a pest.

Myllocerus blandus [*l.c.*, pp. 333-334, fig. 101] is known from Burma, Madras and Bengal, and has been found on maize at Pusa, but this also is scarcely a pest.

Oxya velox is found in numbers on maize throughout India and does some damage by eating the leaves and especially the young plants.

In the Punjab, when the maize crop is young, it is attacked by ground-grasshoppers, chiefly *Oxya* and *Epacromia*.

When the crop is young, bagging is practicable.

Hieroglyphus banian sometimes attacks maize in some districts in which this grasshopper occurs. We have already dealt with it under sugarcane and paddy.

In Madras *Hieroglyphus banian* is found on maize.

In Khandesh also maize is attacked by *H. banian.*

Epacromia tamulus is found in most districts, but chiefly in Southern India. It occurs on maize and may do damage by eating back the young leaves and shoots of seedlings. **Mr. Fletcher.**

Chrotogonus spp. also attack young plants chiefly.

All these grasshoppers may be bagged when doing damage to the young plants. In the case of older plants it is not practicable to get at them but grown plants are relatively little attacked.

Boring in maize-stems we get :—

Chilo simplex.
Sesamia inferens.
,, *uniformis.*

Chilo simplex occurs in maize in the same way as it does in *juar* and is an important pest of this crop. We have already considered it in some detail under *juar* and I do not think there is anything to add as regards maize. It is of course possible that more than one species may be included under the name *Chilo simplex.*

Chilo simplex is sometimes bad in the Punjab on maize. **Mr. M. M. Lal.**

It is also bad at Pusa, riddling the plant and attacking it in all its stages of growth. **Mr. Ghosh.**

Sesamia inferens occurs commonly in maize stems and *S. uniformis* has been reared from maize at Lyallpur and Pusa. The former is distinctly a pest, at times serious. **Mr. Fletcher.**

As already noticed under paddy and *juar*, the larvæ rest for some time in the stubble and prompt destruction of this is indicated as a remedial measure.

The heads, or cobs, of maize are attacked by :—

Heliothis obsoleta.
Chilo simplex.

Heliothis obsoleta has been reared at Pusa from larvæ boring in maize-cobs, and this method of attack is probably general in India, as is the case in other parts of the World, such as the United States of America. As regards maize, however, in India *H. obsoleta* is not much of a pest.

Heliothis obsoleta occasionally attacks the stem of maize, gnawing it from outside and entering inside the stem, the part attacked being the tender top portion. **Mr. Ghosh.**

Chilo simplex has also been bred from maize-cobs at Pusa and may occur in some numbers, but we do not seem to have any record of this habit outside of Pusa. **Mr. Fletcher.**

In the Punjab also *Chilo simplex* has been found boring into the cobs. **Mr. M. M. Lal.**

The roots of maize are attacked by the usual insects :—

Anomala polita.
Pachnephorus impressus.
Myllocerus 11-pustulatus.
,, *discolor.*
Termites.

There is not much to say about these that we have not said already in the case of other crops. Termites are not common on maize and probably rarely attack growing healthy plants, and the beetle larvæ, though common, probably do comparatively little damage.

Anomala grubs, presumably *A. polita*, are found commonly around the roots. Doubtless a good many species occur.

Pachnephorus impressus is found in the larval state commonly at maize roots. [See Entomological Note 33, Bulletin 59.]

Myllocerus 11-pustulatus and *M. discolor* have both been bred in numbers at Pusa from larvæ found in the soil amongst maize-roots. But it is doubtful how far any of these insects are to be regarded as regular pests.

The sucking insects found on maize include :—

Leptocorisa varicornis.
Calocoris angustatus.
Megacœlum stramineum.
Pyrilla perpusilla.
,, *aberrans.*
Phenice mœsta.
Pundaluoya simplicia.
Delphax psylloides (?).
Aphids.

Leptocorisa varicornis has been considered under paddy. It is found on maize, not uncommonly at times, but is scarcely a pest.

Calocoris angustatus and *Megacœlum stramineum* have been considered under *juar*. Both occur on maize also but do not do so much damage as to *juar*.

Pyrilla perpusilla and *P. aberrans* have been considered under sugar-cane and there is not much to add. They may occur on maize but usually in small numbers doing little damage.

Phenice mœsta is found on maize leaves at times but is not known to do damage at all.

Pundaluoya simplicia is found on maize, as a pest chiefly in South India, but is probably widely distributed. It is rather a pest of *juar* than of maize, but the latter crop is occasionally attacked, generally in isolated patches.

Liburnia psylloides seems to be a name rather than an insect. It is described lunder the name of the "Maize Fly" in "Indian Insect Pests," pp. 37-138, fig. 155. It is probably the same insect as *Pundaluoya simplicia.*

Aphids occur on maize, sometimes in large numbers and are probably the most important pests so far as sucking insects are concerned. Isolated plants or patches of plants are attacked as a rule and control-measures are not generally required.

Aphids are sometimes bad in the Central Provinces. **Mr. Ratiram.**

A species of Aleyrodid has also been noticed on one occasion on the leaves of maize in the Central Provinces.

WHEAT (*Triticum vulgare*).

Wheat seedlings are attacked by :— **Mr. Fletcher.**

Chrotogonus spp.
Tanymecus indicus.
Elaterid grubs.
Spodoptera mauritia.
Microtermes obesi (*anandi*).

Chrotogonus spp. and other ground grasshoppers take their toll of wheat seedlings and may do considerable damage at times. Bagging is usually effective as a control.

Tanymecus indicus [*Fauna of India, Curculionidæ,* Vol. I, p. 99, fig. 32] is a sporadic pest of wheat seedlings, the adult beetles hiding under the loose clods in the fields and nibbling off the young germinating plants. In the Punjab this species has been noted as an occasional bad pest of young wheat when the plants are about five to six inches high. As regards control, split pumpkins or *bael* fruits are placed in the fields at dusk and examined before sunrise and large numbers of beetles are sometimes trapped in this way. This species is recorded from Assam, Bengal, Bihar, the United Provinces and Punjab.

Elaterid grubs of various species are often found in numbers in wheat-fields and may perhaps do some damage but their status as pests is at present doubtful. Some species at all events are predaceous and feed on caterpillars and other insects, so that they are beneficial. In this

connection we may recall the case of *Liogryllus bimaculatus* in gram-fields, when it feeds equally on caterpillars and on the contents of gram-pods.

Spodoptera mauritia, which we have already considered under paddy, is also an occasional pest of wheat seedlings, on which it has been found at Pusa. But it seems to be a relatively unimportant pest of wheat.

Microtermes anandi is the small Termite usually responsible at Pusa for damage to wheat seedlings and it is probably this same species which attacks wheat seedlings in other districts also. It nests in the ground without any indication in the shape of a mound to show where its nest is, but this may at times apparently be situated at a considerable depth underground. At Pusa when excavations were being made for the Drain Gauges, the tunnels of this species were found at a depth of about eleven feet below ground-level. Scattered small chambers seem to occur almost anywhere underground and those belonging to *Microtermes* may easily be recognized by the fact that they are quite small, usually rather globular in shape and contain a small mass of comb whose exterior surface has a characteristically roughened appearance. To deal directly with these termites in wheat areas seems to be rather impossible as it is not possible to locate and destroy their nests directly and the enormous areas to be dealt with must also be borne in mind. It is possible that deep-ploughing, such as is done with steam tackle at Pusa, may so disturb the upper strata of soil that the termites may be driven down at least until the plants have attained a good growth; but this requires experiment and in any case is not possible in small holdings. In irrigated areas, a deterrent may be used in the irrigation water, but this again is possible only in some localities.

It is generally the seedlings which are attacked—we shall come presently to the case of termite attack on grown plants—and, once they have made a little growth, they seem to be fairly immune.

In the Punjab termites are very bad on wheat seedlings.

In the Central Provinces wheat seedlings are also seriously attacked by termites.

My experience in the North-West Frontier Province is that wheat when sown by drills suffers more than when sown broad-cast. I have further observed that the trouble from termites is much greater in light soils than in heavy soils.

I can corroborate Mr. Robertson-Brown's latter statement. In Northern Gujarat wheat in black soil areas is not much attacked by termites.

The next group of insects includes those feeding on the leaves of the wheat plant. Some of these, of course, may feed on seedlings also and some pests of seedlings may eat leaves of well-grown plants. **Mr. Fletcher.**

Flea-beetles.
Monolepta signata.
Myllocerus discolor.
,, *blandus.*
Cirphis unipuncta.
,, *loreyi.*
,, *fragilis.*
Dasychira securis.
Epacromia tamulus.

Flea-beetles sometimes occur in numbers, chiefly on young leaves, and may do some damage at times, but they are minor pests as a rule. The identification of Indian Halticinæ is an unworked field at present.

Monolepta signata has been found on wheat at Coimbatore and doubtless occurs in most districts, but it is not a regular pest of wheat, so far as we know.

Myllocerus discolor [*Fauna of India, Curculionidæ*, Vol. I, pp. 348-350, fig. 106] has been found on wheat leaves at Pusa and Coimbatore and occurs throughout India. The larva probably feeds at the roots of wheat also. This species is scarcely a pest as a rule.

Myllocerus blandus [*l.c.*, pp. 333-334, fig. 101] has also been found on wheat at Pusa, but is not a pest.

Cirphis unipuncta is represented in the Pusa Collection by specimens reared on wheat at Peshawar and Pusa. It is often abundant in the larval stage in cracks and under clods in wheat-fields and must do a considerable amount of damage in the aggregate, but it is not usually regarded as a serious pest of wheat.

Cirphis loreyi is found with *C. unipuncta* in wheat-fields and is often common, although it is not usually regarded as a pest. It is probable that both these species of *Cirphis* escape notice because the larvæ feed by night and hide away in the daytime.

Cirphis fragilis is recorded by Hampson [*Cat. Lep. Phal.* V. 546, t. 93, fig. 26] to do " much damage to wheat in Chindwara District, Central Provinces," but it is not known to have occurred as a pest of late years. It is perhaps a sporadic local pest.

Dasychira securis occasionally occurs on wheat but does very little damage as a rule.

In Burma *Dasychira securis* occurs on wheat leaves but not as a pest. **Mr. Shroff.**

Epacromia tamulus and other grasshoppers occur, often in numbers, in wheat areas and must do some damage, but it is scarcely perceptible as a rule.

Boring in the stem of wheat plants we get *Sesamia inferens*. *Sesamia uniformis* does not seem to have been bred from wheat so far. We have *inferens* recorded from wheat at Surat, Nagpur, Seoni and Pusa, and it probably occurs throughout the wheat-growing areas in India, but it is scarcely a pest and direct control seems rather out of the question, except in so far as the stubble question is concerned.

Sesamia inferens is found in the Punjab but is not serious.

At Pusa also it is not serious.

Besides the usual micellaneous lot of cockchafer grubs and so on the roots of wheat plants are attacked by

Microtermes obesi (*anandi*).

Aphids.

Microtermes obesi (*anandi*) has just been considered under the heading of seedlings. In some districts, however, notably in the Central Provinces, wheat plants are attacked just when they are coming into ear and the damage done may be serious, two to three annas in the Rupee in normal years and four or five annas in bad years. Damage of this sort occurs at Hoshangabad and the subject was taken up for investigation in 1910 by Mr. Lefroy. He visited the Farm and mapped out all the visible termites' mounds, which occur as a rule along the field embankments, and started a series of experiments on the extermination of these nests by (1) digging them out, (2) oiling with low-grade kerosine oil and digging them out, and (3) simply pouring a bottle of low-grade kerosine oil into one of the main galleries of the nest. In 1911, when Mr. Lefroy went on leave, I took over this work and visited the Hoshangabad Farm in September 1911 and noted results to date and continued the experiments with the new mounds which had showed up. The experiments carried out at that time appeared to have demonstrated that the simple oiling of nests is sufficiently effective to render this worth while. As careful estimation of that year's wheat crop on the Hoshangabad Farm showed that one-third of the total crop had been destroyed by termites it was reasonably supposed that the cost of treatment (about one anna per mound treated) would be more than repaid by increased out-turn, and an experiment on these lines was arranged to be done by the Deputy Director of Agriculture, one block of wheat fields to be left untreated and in another similar block of fields all the mounds being destroyed.

In February 1912 I visited Hoshangabad again to see the result of this experiment, but no apparent difference was perceptible. The

attack happened to be in progress at the time of my visit, as the wheat was just coming into ear, and the attacked plants were plainly visible, showing up in yellow patches against the green of the healthy plants. It was evident that the suppression of the mound-nests had made no difference in the area treated and further observation showed that the attacked patches had no apparent relation to the positions of the mounds, so that it began to look doubtful whether termites were really responsible for the damage at all. This point, however, was soon set at rest by examination of the plants which were actually being attacked. On carefully digging these up, termites were actually found in the act of cutting the stem below ground-level, but it was at once evident that the termites doing the damage were not the same as the mound-builders. The mound-builder was an *Odontotermes, O. obesus* for the most part; the termite damaging the wheat plants was a *Microtermes*, since identified by Professor Holmgren as *M. anandi*, which I have since ascertained to be the same species as *M. obesi.*

Now, that is another case in which the importance of systematic work is obvious. If I had not happened to visit Hoshangabad at that time and to secure specimens of the *Microtermes* in the act of damaging the wheat plants, we should probably have gone on destroying the mounds of the *Odontotermes*, which was not the culprit after all, and furthermore we should have been utterly at a loss to reconcile the want of relation between destruction of the mound-nests and continuance of the attack. Because wheat was being damaged by termites and a mound-building *Odontotermes* was common in the locality, it was presumed that the *Odontotermes* was the cause of the damage; which was not the case as it happened. Similarly, borers in cane and *juar* were all lumped together as *Chilo simplex*, and other similar cases may be adduced. We have, for example, seen under sugarcane that there is considerable doubt regarding the identity of the common Hispine beetle found on cane at Pusa and represented on our coloured plate as *Phidodonta modesta*. Other similar cases will probably crop up, as we get to know our common insects a little better, but I want to impress upon you the necessity for not jumping to conclusions and lumping several things together merely because they look a little alike or happen to be found on the same food-plant.

Aphids on the roots of wheat plants were found at Hoshangabad. As a result of attack the plants dried up. **Mr. Ratiram.**

Damage of wheat plants by root-feeding Aphids does not seem to be general in India. At all events, we do not seem to have heard of it before. **Mr. Fletcher.**

The sucking insects on wheat include :—

Nezara viridula.
Dolycoris indicus.
Macrosiphum granarium.

Nezara viridula, Dolycoris indicus and various other polyphagous Pentatomid bugs are sometimes found in numbers on wheat, but are not known to be pests.

Macrosiphum granarium—there is some doubt about the correct name—is the usual Wheat Aphid which occurs commonly all over India and often does damage. In some districts it is a common practice to grow mustard either intersown with wheat or alongside the wheat-fields and the mustard plants are usually affected with Aphids which attract Coccinellids and other predators; later on, when the Wheat Aphid comes along and starts multiplying on the wheat plants, its natural enemies are already present in numbers and keep it in check. There is also a small Braconid—which has been identified as *Aphidius avenæ*, but by whom and with what degree of accuracy I cannot say—which attacks these Aphids and helps to keep them in check. Beyond the encouragement of natural checks in this way it is not usually possible to do much in the way of control on a field-scale in the case of the Wheat Aphid.

The grain is attacked in the field and before storage by *Holcomyrmex scabriceps*, which sometimes is the cause of quite serious losses to the cultivator by the quantity of grain which it carries away. So much is this the case that in times of scarcity in some districts it is the practice to dig out these ants' nests and to utilize the stores of grain.

At Peshawar *Holcomyrmex scabriceps* has been noticed to take away wheat-grains from the field when these have been sown.

Occasionally rats also are troublesome by carrying away the broad-casted wheat seed.

The remedy would seem to lie in treatment of the seeds to make them unpalatable. Probably storage with naphthaline would make them distasteful to ants. But damage of this sort seems to be unusual. *Holcomyrmex* is usually a pest of stored grain and may carry off quite large quantities of grain from stores.

OATS (*Avena sativa*).

The pests of oats are very similar to those of wheat, although we seem to have very few insects recorded as found on oats.

On the leaves we find *Cirphis unipuncta* and *Cirphis loreyi* in the same way as on wheat. Last year when I was at Peshawar in May there

was a small patch of oats on the Farm at Taru and this was swarming with larvæ of *Cirphis,* mostly *unipuncta* with a few *loreyi.*

The Hispine which we have known as *Phidodonta modesta* has also been found on oats at Pusa.

BARLEY (*Hordeum vulgare*).

We seem to have very few insect pests of barley on record. **Mr. Fletcher.**

Spodoptera mauritia was found doing damage to barley at Ootacamund, presumably to the young plants. I believe that attempts were made to grow barley in the Nilgiris, but it had to be given up on account of insect attack, chiefly by cockchafer grubs.

The roots also are attacked by Termites, chiefly when the plants are young.

The next group of plants includes the various Millets and of these the first is—

MARUA or *RAGI* (*Eleusine coracana*).

[*Marua*—Hind. *Ragi*—Madras.]

The leaves of *marua* are eaten by a good many insects, but few are of any great importance as pests.

Estigmene lactinea.
Amsacta albistriga.
Dasychira securis.
Marasmia trapezalis.
Epacromia tamulus.
Orthacris sp.
Cyrtacanthacris ranacea.
Monolepta signata.
Myllocerus 11-pustulatus.

Estigmene lactinea is sporadically a serious pest of *ragi* in Madras. Prompt hand-picking, before the pest gets out of hand, is the only remedy. But its occurrence is generally quite sporadic

Amsacta albistriga, and probably *A. moorei* also, will eat *ragi* leaves when the caterpillars are abundant, but they are not specific pests of *ragi.*

Dasychira securis and *Marasmia trapezalis* occur on *ragi* as on other cereals, but are scarcely pests.

Epacromia tamulus, *Orthacris* sp., *Cyrtacanthacris ranacea,* and doubtless other common grasshoppers also occur more or less casually on *marua* and may do minor damage at times.

Monolepta signata and *Myllocerus 11-pustulatus* are both very general feeders, also found on *marua*, but not as pests.

Boring insects found in *ragi* include :—

Saluria inficita.
Chilo simplex.
Sesamia inferens.

Saluria inficita is a specific pest of *ragi* and is described and figured in "South Indian Insects," pp. 427-428, fig. 304. The larva bores low down in the stem, near the roots. This insect occurs every year at Coimbatore about August but has not yet been noticed elsewhere, although it is probably more widely distributed.

Chilo simplex occurs in *ragi* and that is about all we can say. It is scarcely a pest of this plant.

Sesamia inferens ["South Indian Insects," pp. 379-380, tab. 21] is a bad pest of *ragi* in Madras but in other parts of India it seems to be of minor importance.

The heads of *marua* are attacked by—

Anatona stillata.
Leptocorisa varicornis.

Anatona stillata ["South Indian Insects," p. 282, fig. 122] is recorded as attacking *ragi* heads in the Bellary District, devouring the pollen of flowers and the milk of developing grains.

Leptocorisa varicornis also sometimes sucks the ripening grains but is of little importance as a pest as a rule.

Leptocorisa has been noted on *marua* ear-heads at Pusa, but only in small numbers.

It is found in the Central Provinces also.

The sucking insects found on *ragi* include :—

Nezara viridula.
Ragi Root Aphis.

Nezara viridula is sometimes found on this, as on nearly all other crops, but is of very minor importance as a pest.

The Ragi Root Aphis was first described in "South Indian Insects," pp. 502-503, fig. 390, but has not yet been identified, and I do not think there is any more to add to the account given. It seems to occur at Coimbatore regularly every year and is often a serious pest.

SETARIA ITALICA.

[*Kauni*—Hind. *Tenai*—Madras.]

Kauni, or *Tenai*, has few specific pests, but is attacked by a good many polyphagous insects.

The leaves are eaten by—

Colemania sphenarioides.
Hieroglyphus nigro-repletus.
Myllocerus dentifer.

Colemania sphenarioides and *Hieroglyphus nigro-repletus* occur in Mysore and the Bellary and Kurnul Districts of Madras and destroy *tenai* together with other crops. We have already considered these insects under *cholam*.

Myllocerus dentifer has been noted on *tenai* at Palur, in South Arcot, but is not a pest.

The flowers of *Setaria italica* form a rather favourite food of various Cetoniad and Meloid beetles. I have on my list :—

Anatona stillata.
Gnathospastoides rouxi.
Lytta tenuicollis.
Zonabris pustulata.
Cantharis ruficollis.

These eat the pollen grains and the young developing grain. I do not think there is anything special to say about any of them.

In the stems of *tenai* there occurs an Erotylid beetle, a species of *Languria*, I think, about which we had a short note recently in the *Agricultural Journal of India*.

Mr. Ramachandra Rao. This Erotylid was found attacking *tenai* at Coimbatore. The eggs are laid in slits made in the upper layer of the leaf. The injury done is similar to that done by a borer. The ears become discoloured and wither.

Saluria inficita also was found boring at the base of *tenai* stems in Bellary.

Mr. Fletcher. That is an interesting record. It is the first time that *Saluria inficita* has been found outside of Coimbatore and in any plant other than *ragi*.

The sucking insects found on *kauni* include the usual bug pests amongst which we need only specify *Dolycoris indicus* and *Leptocorisa varicornis*, of which the latter is found sucking the young grain in the same way as on other cereals. But none of these bugs are of any great importance as pests.

SETARIA GLAUCA.

This has probably much the same insects on it as *S. italica* but we do not seem to have any definite records at all.

Panicum frumentaceum.

[*Sama*—Hind.]

The only insects recorded on this are *Myllocerus 11-pustulatus*, which has been found at Pusa and the *cholam* Anthomyiad fly which has been reared at Coimbatore. It is also attacked by *Leptocorisa* and probably many other common pests of cereals.

Panicum miliaceum.

[*China*—Hind.]

The *cumbu* Anthomyiad Fly has been reared from this plant at Coimbatore. We have already discussed it under *cumbu*, and I have no more to add.

At Pusa a Fly maggot attacks the stem of *china* before the ear ripens. The effect produced is like that of a borer, the ear drying up without forming any grain. The affected plants are easily spotted in the field. This insect was first noticed at Pusa in September 1916.

The leaves and grain of *china* are sometimes attacked by *Cantharis actaeon*. We had an example of this near Pusa in July 1915, when the beetles were found swarming in a *china* field. They are fairly easily collected by hand when in numbers.

Panicum miliare.

[*Gandhli*—Chhota Nagpur. *Panivaragu*—Madras.]

We do not seem to know of any specific pest of this crop.

At Coimbatore we get a Flea-beetle which is peculiar to this millet. The eggs are laid on the leaves. The larva bores in the stem and, as a result of the attack, the ears dry up. The larva drops to the ground when full-fed and pupates there.

A Stem-fly attacks *gandhli* also, in the same way as *china* is attacked. Specimens of this were sent in from Ranchi on one occasion.

Paspalum scrobiculatum.

[*Kodon*—Hind. *Kodra*—Gujarat. *Varagu*—Madras.]

Varagu is subject to attack by the *cholam* Anthomyiad fly, but this is probably not a serious pest.

In the Central Provinces *kodon* is attacked by *Cirphis unipuncta*, *Leptocorisa varicornis* (on earheads), Meloid beetles, *Nephotettix*, and

Oxya velox. All these have been considered already and there is no more to add now.

In Gujarat the larva of *Amsacta moorei* attacks *kodra* in common with all other crops.

GRASSES.

Mr. Fletcher. We will next take the insect pests of grasses generally. These are sometimes of importance in grazing areas and in the case of gardens, lawns, etc.

Hodotermes viarum is a common termite in some parts of Madras, as at Coimbatore, and often does damage to grass lawns by cutting off the stems and carrying the cut portions below ground. It is a most interesting species of termite, both the workers and soldiers being provided with eyes; most termites, as you know, are entirely blind in the worker and soldier castes. It tunnels below the ground, throwing up little hillocks of loose pellets of earth at intervals, and in the evening and early morning the workers sally out in the open and cut off pieces of grass which they carry into their galleries. The soldiers generally remain in the open gallery, ready to repel any intruders, but sometimes come out and run about over the ground, apparently urging the workers to hasten in their task. When sufficient grass has been collected, the workers all scuttle back into the gallery which is promptly blocked up with pellets of earth. When these termites are in numbers, they may produce regular bare patches on lawns.

Eutermes heimi, which also occurs at Coimbatore, has somewhat the same habits, but often feeds on dead *cholam* stalks or similar dead vegetable matter. However, it does cut living grass on occasion and so may do a little damage.

Other species of Termites sometimes damage grass by cutting the roots but we seem to have no exact records of the species concerned.

Euxoa spinifera occurs throughout India, Burma and Ceylon, the larva feeding at the roots of grasses, especially *Dubh* grass (*Cynodon dactylon*). It is usually a very minor pest, but occurs sporadically in enormous numbers at roots of grasses. When in numbers it is usually attacked by birds such as hoopoes, crows, etc., and the only control that can be used is flooding where that is practicable.

Spodoptera mauritia, which we have already discussed in connection with paddy seedlings, feeds normally on grasses and may do damage on grass farms.

Prodenia litura also sometimes occurs in numbers on grass. We have already discussed *Spodoptera* and *Prodenia* and I do not think there is any more to add here.

GUINEA GRASS (*Panicum jumentorum*).

Guinea grass is grown as a fodder crop and its pests are checked automatically by frequent cuttings. It is grown to some extent at Pusa but we have not had much trouble with insect pests.

The larvæ of *Porthesia xanthorrhœa* are sometimes found in small numbers but are scarcely pests.

Dasychira securis also is found in small numbers at times.

Dasychira securis has occurred on Guinea grass at Coimbatore but not as a serious pest.

Sesamia inferens also has been reared from larvæ boring in the stems but this only occurs when the grass is allowed to grow tall. When the grass is cut regularly for fodder, as is generally done, *Sesamia* does not do any damage.

BAMBOOS (*Bambusa* and *Dendrocalamus* spp.)

Bamboos are mostly grown on a large scale in Forest Areas but are also often grown in Agricultural Farms, gardens, etc., and you may be called on to treat them for insect pests.

Bamboo leaves are not attacked by any serious pests in the way of caterpillars. *Matapa aria* is a Hesperiad butterfly common in most parts of India, Burma and Ceylon ; the larva rolls bamboo leaves quite commonly, but is scarcely a pest. *Telicota augias* is also recorded as rolling bamboo leaves, but is not a pest. *Crocidophora ptyophora*, a Pyraustine Pyralid, has also been reared at Pusa from larvæ rolling bamboo leaves, but it is not a pest.

The young shoots of bamboos are bored by larvæ of Fruit-flies of the genus *Stictaspis*. *Stictaspis ceratitina* has been reared at Pusa in September from purple larvæ found in bamboo shoots and *S. striata* from larvæ in *Dendrocalamus* shoots at Peradeniya.

The shoots of bamboo are also attacked by the giant weevils of the genus *Cyrtotrachelus*, which are known to occur in Bengal. *C. longipes* is recorded by Stebbing [*Forest Coleoptera*, p. 440] from the Chittagong Hill Tracts and we have it from Lebong, Darjiling District, reared from larvæ boring growing shoots of bamboo. In the Darjiling District *C. dux* is also found attacking bamboos in the same way.

The pests of bamboos which are most commonly noticed are the sucking insects, which sometimes occur in large numbers. Of these we may note :—

Oregma bambusæ.
A Woolly Aphid.
A Fulgorid bug.
Scale Insects.

Oregma bambusæ is described in "South Indian Insects," p. 505, fig. 392. It occurs as a rule on the underside of the leaves of *Dendrocalamus,* sometimes in very large numbers so that the plant is conspicuously smothered and blackened by a sooty fungus which grows on the honey-dew excreted by this Aphid. It seems to occur every year at Coimbatore about December and I have also seen it in Bangalore and it is probably common throughout Southern India.

A Woolly Aphid was also common on bamboo at Coimbatore in December 1916, completely covering the young shoots and leaves.

A Fulgorid bug has also been found at Coimbatore inside the lower sheathing leaves.

Scale-insects of several sorts occur on bamboo in India but they have been observed little and collected and identified scarcely at all. *Chionaspis decurvata, Antonina anceps* and *Asterolecanium miliaris* have been collected on bamboos at Poona and identified by Mr. Green. An *Asterolecanium* is common at Pusa and doubtless throughout India.

Dried bamboos of course are subject to attack by a number of insects, especially beetles, such as *Caloclytus annularis, Stromatium barbatum, Myocalandra exarata, Dinoderus,* etc , but we can only deal now with pests of the growing plant. The list of known pests is very small and could doubtless be extended considerably by a little search.

Grasses lead us on to Fodder Crops and we will now take the pests of lucerne, *senji, shaftal* and *bersim.*

LUCERNE (*Medicago sativa*).

Lucerne is attacked by a good many insect pests, the most important of which are caterpillars, but the regular cutting of the plants when grown for fodder provides a certain amount of control in itself. If the crop is allowed to grow for any length of time it is often completely destroyed by caterpillars, especially *Laphygma exigua.*

Mr. Robertson-Brown. That is a difficulty in the North-West Frontier Province. Lucerne or any leguminous crop cannot be grown for making hay because, before the crop has grown to the required height, the leaf-eating caterpillars appear and destroy it.

Mr. Fletcher. The caterpillar and other pests concerned are :—

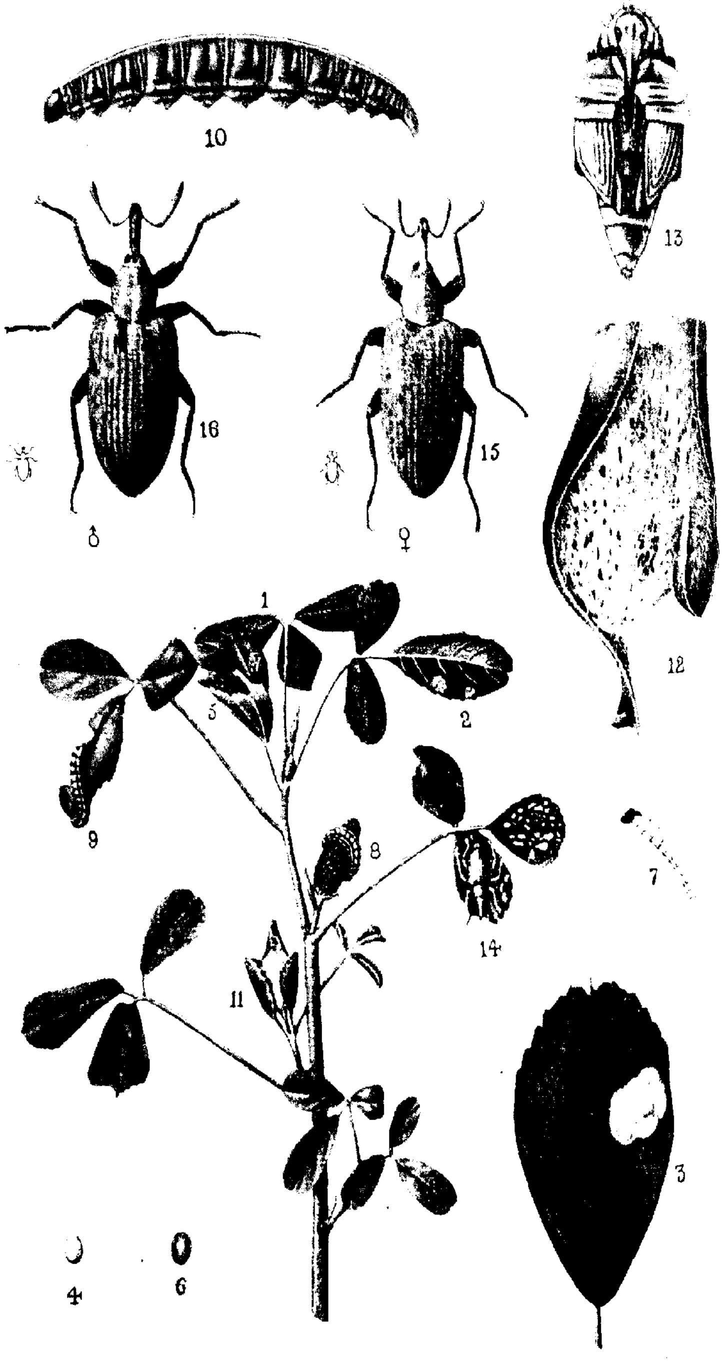
Laphygma exigua.
Prodenia litura.
Heliothis obsoleta.
Agrotis ypsilon.
Chalciope hyppasia.
Creatonotus gangis.
Craspedia defamataria.

Nacoleia indicata.
Dichomeris ianthes.
Lytta actæon.
,, *picta.*
Hapalochrus fasciatus.
Aulacophora abdominalis ?
Flea Beetles.
Monolepta signata.
Hypera medicaginis.
,, *variabilis.*
Sitones crinitus.
Tanymecus hispidus.
Thrips.
Aphids.

Laphygma exigua [" South Indian Insects," pp. 378-379, fig. 240] is the worst caterpillar pest found on lucerne, and occurs throughout India. The life-history is very short, only about three weeks, so that the numbers increase at a very rapid rate, and in bad cases of attack the area concerned may be swarming with the caterpillars. Control was dealt with in Bulletin No. 10, pp. 13-14, and the *Agricultural Journal of India*, Vol. I, pp. 338-350, tab. 23, and we touched on it also under the heading of indigo. In the case of lucerne, or similar fodder crops, ordinary spraying with a stomach poison is out of the question but careful spraying could be done of the stumps left after cutting. The regular cutting of the crop in itself provides a mechanical control but it is obvious that there will be a tendency for the caterpillars to migrate from the cut areas to other areas with growing plants, if these are adjacent. Cutting should be as close back as possible and should be regulated so as to prevent this migration as far as possible and the plots should be separated by steepsided trenches or small ditches. A number of caterpillars can be collected by using bag-nets but many drop down and this is not an absolutely effective method. The eggs are laid in batches on leaves but are not sufficiently conspicuous to make it practicable to collect them under field conditions. One thing to be noted about this insect is that it does not seem to have regular broods ; in the case of a bad attack, the insect is found in the plots in all stages at the same time and this of course makes control more difficult.

Prodenia litura also sometimes occurs in some numbers on lucerne but is not so serious a pest as *Laphygma*. Control will be similar.

Heliothis obsoleta, *Agrotis ypsilon*, *Chalciope hyppasia* and *Creatonotus gangis* all occur at times but are not common as pests.



HYPERA MEDICAGINIS.

Hypera medicaginis.

Figs. 1 to 6 show fresh and older (black) eggs.
Figs. 7 to 10, newly hatched and fullgrown grubs.
Figs. 11 and 12, cocoon.
Fig. 13, pupa.
Figs. 15 and 16, beetle, female and male.
Figs. 1, 2, 5, 8, 9, 11 and 14, are about life-size; other figures are magnified, the outline and life-size figures indicating the natural sizes.

Craspedia defamataria occurred on lucerne at Pusa in some numbers in 1906 but has not since been noticed as a pest.

Nacoleia indicata is also found on lucerne but not in numbers.

Dichomeris ianthes has been reared on lucerne at Pusa and may be a sporadic pest.

Cantharis actæon and other Meloid beetles sometimes occur on lucerne and do a little damage. They are easily collected and it should be remembered that many of these beetles are useful in their early stages when they are predaceous on grasshoppers' egg-masses.

In North Gujarat *Lytta picta* is found eating the leaves of lucerne. **Mr. Jhaveri.**

Hapalochrus fasciatus, a Melyrine Malacodermid beetle, has been found on lucerne at Pusa but is not a pest. **Mr. Fletcher.**

Aulacophora abdominalis has also been noted on lucerne but there seems to be some doubt about the identity of the species concerned and *A. abdominalis* is not a pest of lucerne so far as we know.

I have seen a beetle, which I think was *Aulacophora abdominalis*, feeding on lucerne leaves. **Mr. Ramakrishna Ayyar.**

Flea beetles of various species occur on lucerne, but are not usually important as pests. **Mr. Fletcher.**

In North Gujarat lucerne leaves are eaten by Flea-beetles. **Mr. Jhaveri.**

Monolepta signata occurs on lucerne, as on so many other plants but is not a pest. **Mr. Fletcher.**

Hypera medicaginis is a weevil which occurs fairly commonly on lucerne, the larvæ being curious caterpillar-like animals which feed on the leaves also. The life-history is shown on a coloured plate [*exhibited*] now in the press. The eggs are laid in clusters on leaves and the grub pupates in a cocoon found in a fold of a leaf or sometimes on the ground in suitable crannies. It is a sporadic minor pest. Control is rarely necessary, as the cutting of plants prevents excessive increase. Besides lucerne, it feeds on *akta*, *Lathyrus hirsuta*, and pea.

Hypera variabilis is very similar to the last species. It has been reared on lucerne at Pusa and Lyallpur and also occurs in the Peshawar Valley.

Hypera variabilis is found on lucerne in the Punjab, but not to any great extent. **Mr. M. M. Lal.**

Sitones crinitus has been found at Pusa on lucerne in some numbers, but is not a pest. It also occurs on *senji* and indigo in Bihar, but we do not seem to have any records outside of Bihar. **Mr. Fletcher.**

Tanymecus hispidus has been found on lucerne at Pusa but is not a pest.

Thrips are sometimes found in large numbers on lucerne on the leaves and in the flowers, but we seem to know very little about any damage that they may do and nothing about the species concerned.

In North Gujarat Thrips are found in some numbers on lucerne.

Aphids sometimes occur on lucerne but rarely in injurious numbers. In March 1913, however, we had a report of Aphids on lucerne on the Military Grass Farm at Mhow; they were said to swarm all over the plants, so that many plants died down and the attacked plants, being covered with sticky exudation, were refused as food by horses.

Nematodes at the roots of lucerne were also reported from Mhow, but I do not know of any other report of their occurrence.

Sphenoptera arachidis was noted on a small plot of lucerne on the Experimental Farm at Bellary.

Sphenoptera is not likely to do damage if the crop is cut regularly.

Senji.

(*Melilotus parviflora.*)

Senji is a sort of clover. It has no regular English name that I know of. Its pests are practically the same as those of lucerne. On my list I have :—

Laphygma exigua.
Hypera medicaginis.
" *variabilis.*
Sitones crinitus.

We have just gone over all these and I do not think there is any more to add, as regards *senji* in particular.

At Nagpur Aphids are found on *senji* but are not serious as pests.

At Nagpur also, at Telinkhedi Farm, *Euxoa segetum* did serious damage to clover, the damaged area looking as if cattle had grazed in it. Lead Arsenate baits were tried but attracted very few caterpillars. The affected plots were then irrigated with the result that all the caterpillars were flooded out and picked up by birds. Three irrigations were found sufficient to rid the field of all the caterpillars.

Shaftal.

(*Trifolium resupinatum.*)

Shaftal is grown very extensively in the Peshawar Valley and has much the same pests as lucerne. It is usually swarming with larvæ of *Laphygma exigua* in all stages of growth and this is undoubtedly the worst pest of this crop. The larvæ of *Colias hyale* and *Colias croceus*,

race *fieldi*, are also said to have occurred as occasional minor pests of this crop; but I have never myself found the caterpillars on it. Mr. Robertson-Brown has already told us of the virtues of *shaftal* as a cover-crop for sugarcane and I may add that in the daytime it also provides shelter for innumerable numbers of mosquitos.

Bersím.

(*Trifolium alexandrinum*).

Bersím is grown extensively in the North-West Frontier Province, Baluchistan, Sind and other parts of India. Its pests are identical with those of *shaftal* and call for no special comment. It seems likely that *bersím* cultivation will become extended in India and we shall then hear of more pests; but the worst is likely to be *Laphygma* and that can only be controlled by frequent and regular cuttings, as we saw under lucerne. **Mr. Fletcher.**

Aphids occurred on *bersím* at Nagpur also. The plants were sprayed with Crude Oil Emulsion after cutting. **Mr. Khare.**

We will next take the pests of— **Mr. Fletcher.**

FRUIT-TREES

and of these we will deal first with pests of *Citrus* of various species (oranges, limes, lemons, pomelo) and allied trees, as the pests of all these are very similar.

Oranges, etc. (*Citrus* spp.).

Young *Citrus* plants are attacked especially by *Phyllocnistis citrella*, whose larva mines in young leaves and does serious damage in the case of young plants where there are only a few tender leaves present. The life-history is shown on a new coloured plate [*exhibited*]. The egg has not been noticed but is perhaps thrust into the leaf tissue. The larva burrows in the leaf, between the epidermal layers, feeding on the green substance and making a mine which develops into a blotch. Pupation takes place in the mine. *Phyllocnistis citrella* occurs in every locality in India where species of *Citrus* are cultivated, but we have no record from Burma. It also breeds on *bael* (*Ægle marmelos*) and on *Jasminum*. As regards control, we usually recommend spraying the affected plants with a mixture of Crude Oil Emulsion and Tobacco Extract, the latter being used because nicotine solution has a peculiarly penetrative action on leaf-tissue and is able to penetrate and kill the larvæ and pupæ inside the mines. Fish Oil Soap could be used instead of Crude Oil Emulsion.

I think that *Phyllocnistis citrella* is more in evidence on the common *Khati*, the ordinary rough lemon.

The leaves of *Citrus* plants are eaten by :—

Phyllocnistis citrella.
Papilio demoleus.
,, *polytes.*
,, *memnon.*
,, *helenus daksha.*
,, *polymnestor.*
Chilades laius.
Tonica zizyphi.
Chrysomelid Beetles.
Peltotrachelus pubes.

Phyllocnistis citrella is chiefly serious on young plants but also attacks young leaves on grown plants and sometimes burrows also under the epidermis of green twigs.

Papilio demoleus is the worst leaf-eating pest of *Citrus* trees and occurs throughout India and Burma. Besides *Citrus*, it occurs on *bael* (*Ægle marmelos*), and *Psoralea corylifolia*. Its lifehistory has been described and figured in "South Indian Insects," pp. 412-413, tab. 25, and more recently in Entomological Memoirs, Vol. V, pp. 33-48, tab. 6, and is well known to you all, so I need not go into that. As regards control, the eggs and larvæ may be hand-picked and in small areas catching the butterflies in hand-nets has been found practicable.

In the North-West Frontier Province, *Papilio demoleus* is the worst pest of *Citrus* plants. Even large plants suffer seriously.

Papilio polytes occurs throughout the Plains of India, Burma and Ceylon. The larva feeds on various species of *Citrus*, of which it is occasionally a minor pest, but generally quite negligible. It also feeds on *Murraya kœnigi.*

Papilio memnon has not definitely been noted as a pest of *Citrus* but at Myitkyina in Upper Burma, I saw butterflies ovipositing on cultivated pomelo trees.

Papilio helenus, race *daksha*, which is confined to the Hill Districts of Southern India, is sometimes a serious pest of orange trees in South Coorg.

Papilio polymnestor is also sometimes a serious pest of orange trees in South Coorg.

Chilades laius occurs in most parts of India, Burma and Ceylon, the larva feeding on orange, lime and pomelo. It is generally found on the top-shoots of orange but is scarcely a pest. An Ichneumonid parasite, *Dioctes vulgaris*, has been reared at Pusa from this species.

In Madras *Chilades laius* is found damaging orange shoots. **Mr. Ramakrishna Ayyar.**

Tonica zizyphi [" South Indian Insects," p. 459, fig. 335] occurs throughout the Plains of India as a very minor pest of orange and lemon, the larva rolling the young leaves. **Mr. Fletcher.**

Chrysomelid beetles were found at Myitkyina in Upper Burma, in September 1914, on orange, eating out patches from the undersurface of the leaves and doing considerable damage. This beetle is a golden-green Cassid, not yet identified.

Peltotrachelus pubes is a weevil found commonly on orange trees in the Shevaroy Hills, where it is apparently a minor pest.

Boring in the stems of *Citrus* trees, we have :—

Stromatium barbatum.
Chloridolum alcmene.
Agrilus grisator.
Gnatholea eburifera.
Arbela tetraonis.

Stromatium barbatum [" South Indian Insects," pp. 321-322, fig. 175] is usually a borer in dead wood but in the Central Provinces it attacks living orange trees. An account of this has recently been given by Mr. Khare in the *Journal of the Bombay Natural History Society*, Vol. XXIV, pp. 610-612. The lifehistory seems to be irregular in length and may extend to two years.

Chloridolum alcmene [" South Indian Insects," p. 323, fig. 177] occurs in the orange-growing tracts in the South Indian Hills, and does serious damage by the larva boring in the stems and large branches. But it seems to be rather sporadic in its occurrence.

When I was in Coorg in October 1915, I found a small orange-coloured Cerambycid (?) grub boring into shoots of orange-trees at Virajpet, in West Coorg. It was in large numbers and was doing great damage, killing back the young shoots. The only remedy was to cut back the shoots and kill the grubs. Unfortunately the beetle could not be reared out, but it was apparently not *Chloridolum*.

Agrilus grisator is recorded in " Indian Insect Life," p. 331, as reared from lemon trees, but we do not know it as a pest.

Gnatholea eburifera was found at Moulmein boring orange trees, but otherwise we do not know of its doing damage.

Arbela tetraonis [" South Indian Insects," pp. 453-454, tab. 41] is widely distributed in the Plains of India and has been recorded boring in orange at Bangalore, Poona and Nagpur. In the Central Provinces it is said to be a pest, although it is a little doubtful whether the species concerned is *A. tetraonis* or *A. quadrinotata*. Be this as it may, the

caterpillars eat the bark under cover of a silken gallery, which generally leads into a tunnel excavated into the tree, usually in the angle of a branch. The caterpillars can sometimes be hooked out with a piece of wire, or their galleries may be syringed out.

Arbela is very common in orange trees at Nagpur. The moths emerge in May and June.

The flowers of *Citrus* are attacked by a few insects :—

Prays citri.
Oxycetonia albopunctata.
Colasposoma semicostatum.

Prays citri I told you about the other day. It occurs in India, probably throughout the Plains, having been found in Coorg and at Pusa. In the South of Europe the larva does serious damage by destroying the flowers of orange, and it is quite possible that it may do damage in India also, although it has not actually been noticed. It is an insect that you might look out for when *Citrus* trees are in flower.

Oxycetonia albopunctata has been found eating lemon flowers at Pusa, but is not a pest as far as we know.

Colasposoma semicostatum is reported to injure orange flowers in Assam.

A beetle attacks the flowers in Assam but I do not know what it is.

The next group of insects comprises those attacking *Citrus* fruits :—

Ophideres fullonica.
Virachola isocrates.
Heliothis obsoleta.
Anthomyiad Fly.
Chætodacus ferrugineus.
,, *caudatus.*
,, *diversus.*

Ophideres fullonica is sometimes a serious pest of pomelo and is especially interesting because it is one of the few cases in which damage is done directly by an adult Lepidopterous insect. The tip of the tongue of the moth is provided with an armament of sharp teeth with which it penetrates the rind of the fruits and sucks them so that they are spoilt. The structure of the tongue is figured in Entomological Note 64, Bulletin 59. At Tardeo, in Bombay, a loss of a quarter to a third of the pomelo crop has been reported as due to this moth, the attacked fruit falling from the trees. This moth is also well known to attack fruit in Australia and South Africa. Control measures are suggested in the Entomological Note just quoted. It is hardly possible to check the increase of the moths as the larvæ feed on *Quisqualis* and wild creepers.

Virachola isocrates is occasionally found boring as a larva in orange fruits but is not a regular pest.

Mr. Khare. *Virachola isocrates* was once reared from orange fruits at Nagpur.

Mr. Fletcher. *Heliothis obsoleta* is probably a mere casual pest of orange fruits but at Peshawar last year some damage was done to young green fruits which were gnawed by caterpillars of this species.

An Anthomyiad Fly occurs fairly commonly in orange fruits and is sometimes reported as a pest, especially in the Hills. It apparently attacks healthy fruit, although we seem to know very little about it. I have seen it in oranges sent from the Nilgiris as infested with " Fruit-flies."

Chætodacus ferrugineus ferrugineus and *C. ferrugineus dorsalis* were both bred by me from larvæ collected in pomelo (*Citrus decumana*) fruits at Myitkyina, Upper Burma, in September 1914. *C. ferrugineus* in its various forms seems to be a rather general feeder in various fruits, such as mango, loquat, guava, peach, etc.

Chætodacus diversus is the Fruitfly figured as " *Dacus* sp." in " Indian Insect Life," tab. 66, fig. 2. It was originally bred from oranges (*Citrus aurantium*) but does not seem to be common.

Chætodacus caudatus has been bred from larvæ in pomelo fruits at Myitkyina, in Upper Burma, and Taung-gyi, in the Southern Shan States. It also breeds in gourds.

We have lately received some Fruitflies bred at Poona from oranges, but they have not been identified as yet. Apparently Fruitflies are not common in *Citrus* fruits in India.

As regards control of Fruitflies, we will consider that when we come to deal with peach pests.

The sucking insects found on *Citrus* trees include :—

Cappæa taprobanensis.
Rhynchocoris humeralis.
Chrysomphalus (Aspidiotus) aurantii.
" " *aonidum (ficus).*
Aspidiotus lataniæ.
Saissetia (Lecanium) hemisphærica.
Aleurocanthus (Aleyrodes) spiniferus.
Dialeurodes citri.
Toxoptera aurantii.
Euphalerus citri.

Cappæa taprobanensis [" South Indian Insects," p. 470, fig. 346] occurs in the Hill Districts of Southern and Northern India as a minor pest of orange trees.

Rhynchocoris humeralis is referred to and figured in Entomological Note No. 94, Bulletin 59. That was the first record of the occurrence of this bug as a pest of orange, but we have since had it sent in from Bassein (Burma) as attacking orange, citron, lime and pomelo, and from Jeolikote, Kumaon District, as puncturing orange fruits an inch deep and completely ruining the orange crop in association with *Cappæa taprobanensis*. These bugs can be caught in hand-nets but are not easy to see when on the bushes, as their colour exactly matches that of the leaves.

Chrysomphalus (*Aspidiotus*) *aurantii* occurs abundantly on *Citrus* at Pusa and probably in most parts of India and may be a bad pest. The infested plants at Pusa were fumigated with Hydrocyanic Acid with success, but this is not generally practicable, and spraying or scrubbing with resin compound and soap is generally fairly effective.

Chrysomphalus (*Aspidiotus*) *aonidum* (*ficus*) has been recorded on orange leaves at Poona and as a serious pest of orange near Khed in the Poona District, the fruits in this latter case being covered with the scales. It occurs as a rule on palms and appears to be rather a sporadic pest on species of *Citrus*. It has been recorded from Calcutta also and is probably widely distributed in India, but the Indian Coccidæ are as yet practically unknown.

Aspidiotus lataniæ has been found on fruits of *Citrus medica* at Poona, or peach at Coonoor and *Phœnix* sp. at Calcutta. It does not seem to be a common pest of *Citrus* in India.

Saissetia (*Lecanium*) *hemisphærica* has been recorded as a rather serious pest of pomelo in the Konkan. It has a wide range of food-plants, but is usually a minor pest of *Citrus*.

Aleurocanthus (*Aleyrodes*) *spiniferus* is a black spiny Aleyrodid sometimes serious on *Citrus*.

A black Aleyrodid is very bad on all *Citrus* plants in the Punjab. The leaves are thickly covered with this insect. As regards remedial measures, the old leaves are collected and burnt and new leaves are sprayed with Crude Oil Emulsion and also with resin compound. Three sprayings have been found to be necessary at intervals of a fortnight. In the case of one area this was done for three consecutive years and there has been no further trouble from this pest experienced in that garden.

In the North-West Frontier Province Scale Insects are generally found on smooth-leaved varieties of *Citrus* plants.

Dialeurodes citri occurs fairly commonly on orange in most parts of India but we do not generally look on it as a bad pest This, however, is not the case in other parts of the World, especially Florida, where

D. citri has proved a very serious pest, so much so that Mr. Woglum, an Expert of the United States Entomological Service, visited the Far East, including India, about six years ago especially to endeavour to collect parasites and predators of this Aleyrodid. You will find an account of this in one of the publications of the Bureau of Entomology and that contains all the information we have about the occurrence of *Dialeurodes citri* in India.

Toxoptera aurantii is apparently the common *Citrus* Aphid in India. It is often abundant and destructive on the young shoots, and is best controlled by a fish oil soap spray.

Euphalerus citri is a Psyllid found commonly on orange plants in India. It is usually a minor pest, occasionally occurring in large numbers. A contact spray, such as fish oil soap, is usually effective.

There is one other sucking insect which is not on my list but about which I want to say a few words, and that is *Icerya purchasi*. It is not on my list, because we have not yet found it in India ; but it is a thing to look out for because we have just received a warning from the Ceylon Government that it has been found in Ceylon and it is therefore possible that it may invade India also. This Scale-insect is a well-known pest of orange and lemon trees in Australia and New Zealand and has also spread to South Africa, Fiji, Hawaii, Portugal, Trinidad, Mexico, and the United States of America. Besides *Citrus*, it may attack a long list of other plants amongst which I may name rose, *Acacia*, grass, *Casuarina*, pomegranate, apple, peach, apricot, fig, pepper, grape, castor, *Polygonum*, potato and *Amaranthus*. I have here some figures [*exhibited*] of this Scale-insect, and I will have copies of these made and circulated, so that you will be in a position to recognize this insect and report its occurrence immediately to Pusa, should you come across it.

BAEL (*Ægle marmelos*).

The pests of *bael* are very similar to those of *Citrus* and hence are rather important because *bael* may provide an alternative food-plant for *Citrus* pests.

On *bael* leaves we get :—

Clitea picta.
Phyllocnistis citrella.
Papilio demoleus.
Myllocerus discolor.

Clitea picta (Chrysomelidæ) is a specific pest of *bael*, attacking the leaves and shoots and often doing a good deal of damage. At Pusa about June the leaves are riddled with patches eaten out by the beetles,

and the young shoots are stunted by the boring of the larvæ, which also tunnel in the petioles and mid-ribs of the leaves. Control has not been applied.

Phyllocnistis citrella mines the leaves of *bael* and *Papilio demoleus* also eats the leaves, both as caterpillars, and need only be noted because *bael* is an alternative food-plant to these pests of *Citrus*.

Myllocerus discolor and other common weevils are found commonly on *bael* leaves but are scarcely pests.

Chætodacus zonatus (*persicæ*) has been reared at Pusa from fallen *bael* fruits which had broken in falling from the tree. So far, it has not been reared from fruit on the tree, but the fallen fruits are capable of providing a breeding-place for this fruit-fly which normally attacks peaches, mango and other fruits.

Aspidiotus orientalis has been found on *bael* but is scarcely a pest. It is recorded from *Osbeckia*, *Cycas revoluta*, *Dalbergia* and *Tamarindus*.

CURRY LEAF PLANT (*Murraya kœnigi*).

Murraya is chiefly grown in Southern India and is important as an alternative food-plant for some *Citrus* pests. If grown near *Citrus* in gardens, therefore, a sharp watch should be kept on the *Murraya* plants.

Papilio polytes breeds on *Murraya*, and is sometimes serious as a pest on this plant.

Papilio demoleus may perhaps feed on *Murraya* also but we seem to have no definite evidence of this in Northern India. In Madras it has been found at times on *Murraya*.

A *Phyllocnistis*, perhaps *P. citrella*, also mines the leaves but the moth has not been bred as yet, so its identity is uncertain.

The Orange Psyllid (*Euphalerus citri*) also occurs on *Murraya*, which may be an alternative food-plant for this insect.

At Coimbatore, a leaf-hopper bug, at present unidentified, occurs in swarms on the shoots, arresting the growth of the plants.

We will go on to the other Fruits, of which the first is the—

MANGO (*Mangifera indica*).

The Mango is grown practically all over India and is indeed the most typically Indian of all fruits and seems to be also the most popular, so far as insects are concerned, judging by the large number of insects found feeding on it.

Mango seedlings are attacked by :—

Termites.
Gryllodes melanocephalus.

Termites, generally species of *Odontotermes*, often attack young mango plants. The only thing to do is to keep them away as far as possible by watering with a deterrent, such as Crude Oil Emulsion.

Gryllodes melanocephalus is also an occasional local pest of young plants.

Mango leaves are eaten by a large number of insects but there are few really serious pests in this group :—

Parasa lepida.
Natada velutina.
Euthalia garuda.
Cricula trifenestrata.
Lymantria beatrix.
Euproctis lunata.
Bombotelia jocosatrix.
Selepa (Plotheia) celtis.
Thalassodes quadraria.
Macalla moncusalis.
Argyroploce aprobola.
,, *erotias.*
Acrocercops spp.
Chelaria spathota.
Anomala dussumieri.
Amblyrrhinus poricollis.
Myllocerus sabulosus.
,, *discolor.*
,, *11-pustulatus.*
Apoderus tranquebaricus.
Eugnamptus marginalis.
Rhynchænus mangiferæ.

Parasa lepida ["South Indian Insects," pp. 410-411, figs. 283, 284] is fairly common on mango in most districts and is occasionally a serious pest, especially on young plants, stripping off the leaves. The young larvæ are gregarious and may be collected by picking the affected leaves or, in the case of gardens, the trees may be sprayed with a stomach poison. The curious round shell-like pupæ are also found clustered in large numbers on tree-trunks and may be crushed. *arasa lepida* has a very wide range of food-plants, including coconut, tea, plantain, and *Ficus* spp. The larva is preyed on by the larvæ of *Phycita dentilinella*, whose small red caterpillar is found sitting on the *Parasa* larva when the latter is about half-grown and ultimately devouring the *Parasa* pupa.

Mr. Ramakrishna Ayyar.

In Madras *Parasa lepida* occurs chiefly on young mango plants.

In Bengal large mango trees may be attacked.

Natada velutina [" Indian Insect Life," p. 500, fig. 335] is also sometimes found on mango but is not common as a rule and has not been noticed as a pest.

Euthalia garuda [*l.c.*, p. 411, tab. 30] sometimes occurs on mango in fair numbers but is not a pest.

Cricula trifenestrata [" South Indian Insects," pp. 405-406, fig. 277] occurs on mango, cashew (*Anacardium occidentale*), *Terminalia*, *Careya arborea* and other trees. It is found throughout the damper districts of Southern India, in North-Eastern India and Burma, and is sometimes a serious pest of mango, especially in Bengal. In bad cases of attack the larvæ strip the leaves and the branches are covered with the masses of the golden-yellow cocoons ; these cocoons may be collected in large numbers and the pupæ destroyed. The larval hairs are poisonous and the caterpillars should be dealt with with some caution. *Phycita dentilinella* parasitizes this insect in its pupal stage, laying its eggs on the cocoon of *Cricula*, the pupa being destroyed by the *Phycita* larva.

Cricula trifenestrata occurs sporadically in Eastern Bengal and is a serious pest when it does occur.

Lymantria beatrix occurs throughout India and Ceylon. The larva has been found feeding on mango at Poona and Pusa but cannot be considered a pest.

Euproctis lunata was recorded as defoliating mango and other trees in Mysore in June 1902, but otherwise we do not know this as a pest.

Bombotelia jocosatrix [" South Indian Insects," pp. 382-383, fig. 245] occurs in Southern and Western India and in Bihar and has been reared on various occasions from mango leaves. It is not common as a rule, but occasionally does some damage.

Selepa (*Plotheia*) *celtis* occurs throughout India and Burma and is an occasional sporadic (sometimes serious) pest of mango. It also occurs on litchi, rose, *Odina wodier*, *Terminalia catappa*, *Gmelina arborea* and various other trees.

Thalassodes quadraria occurs, usually in small numbers, on mango, on which it has been found at Poona and Pusa. In January 1909 it was found in large numbers on mango at Pusa ; so that this species may be a sporadic pest.

Macalla moncusalis [*l.c.*, pp. 429-430, fig. 306] occurs throughout India but has only been noted as a pest of mango in Madras. The larva webs up the shoots and leaves and destroys the young leaves. The webs are conspicuous and easily collected and destroyed with the enclosed caterpillars.

Argyroploce aprobola is widely distributed throughout the Plains and is a very minor pest of mango, on which it has been reared at Poona, Bassein Fort and Pusa, the larva rolling the leaves. It has also been reared from flowers of rose and on leaves of *Cassia tora*, litchi and *Polyalthia longifolia*.

Argyroploce erotias seems to be widely distributed in India and Ceylon. The larva has been found at Pusa rolling tender mango leaves and feeding on them and it was also reared in Bombay from a larva boring mango shoots. Also reared at Pusa from a larva rolling *Loranthus* leaves (probably on mango) and from a larva webbing *Cynoglossum* leaves.

Various species of *Acrocercops* mine mango leaves and some of these are mentioned in Entomological Note 84, Bulletin 59. None are serious pests.

Chelaria spathota [Entomological Note 82, Bulletin 59] also occurs on mango but is not a pest.

Anomala dussumieri is recorded on mango in Travancore but I do not know how far it is a pest, if at all.

Amblyrrhinus poricollis, an Eremnine weevil, has been found at Pusa eating tender mango leaves, as also leaves of *bael* (*Ægle marmelos*), *Albizzia lebbek* and *Dalbergia Sissoo*. We also have it from Cuttack (on *Zizyphus*), from Pithapuram, in the Godavari District (on *Terminalia* leaves), and from Hagari (on *agathi*), but it does not seem to be a pest.

Myllocerus sabulosus, *M. discolor* and *M. 11-pustulatus* have been found eating tender mango leaves at Pusa, and are probably widely distributed as very minor pests.

Apoderus tranquebaricus ["South Indian Insects," pp. 335-336, fig. 193] occurs sporadically on mango in Southern India but is not a pest. The leaf attacked is cut and rolled up by the larva, which feeds on it.

Eugnamptus marginalis [*l.c.*, pp. 329-331, figs. 186, 187] occurs throughout India and Burma. The Pusa collection contains examples from Dehra Dun, Pusa, Nagpur, Poona, and Maymyo, and in Madras it has been noted in Godavari and Malabar. The life-history is described in "South Indian Insects" and has also been worked out at Pusa. Young leaves are usually attacked and considerable damage may be done at times. Control is difficult owing to the small size of the insect. The collection and destruction of freshly-cut leaves containing eggs and young grubs should be done as far as possible and attempts might also be made to catch the adult beetles in hand-nets.

At Pusa the grubs hibernate and some of them aestivate also in the ground. The life-cycle seems to be very irregular but there are probably about three generations during the Rains in North Bihar. **Mr. Ghosh.**

Some beetles appear in March but, the climatic conditions being then unfavourable, the grubs from the eggs laid at that time failed to develop under conditions in the Insectary. Control is simply a question of care in the regular collection of cut leaves, and their destruction by fire.

Rhynchænus mangiferæ is the minute weevil referred to as the "Mango leaf-boring weevil" in "South Indian Insects," p. 334, fig. 192; it has since been described by Dr. Marshall [*Bulletin Entomological Research*, V, 378-379, March 1915] as *Rhynchaenus* (*Orchestes*) *mangiferae*. Besides the localities already given, it has since been found at Coimbatore and Pusa and is probably widely distributed in India, though overlooked. The lifehistory has already been described in my book, and the chief damage done is by the mining of the grubs in the tender leaves. In some cases considerable damage is done and this insect becomes a serious pest. It would be useful to try the effect of a nicotine spray to kill the grubs in their mines.

Rhynchaenus mangiferæ was found at Pusa for the first time, and reared in the Insectary, in 1916. It is not common in Bihar.

Before we leave the subject of mango leaf pests, there is one other insect that might be mentioned, and that is *Œcophylla smaragdina* ["South Indian Insects," p. 276, figs. 114, 115], the common red tree ant, which frequently nests in mango trees and becomes a serious nuisance to the fruit pluckers in the mango season.

Œcophylla smaragdina sometimes also spoils a number of young leaves by tying them together; in such cases the growth of the young shoots is interfered with.

Systematic destruction of the nests by burning them out will reduce their numbers considerably, but one would rather like to see the effect in the way of increase of caterpillar pests afterwards.

The shoots of mango are attacked by several insects: –

Chlumetia transversa.
Anarsia melanoplecta.
Alcides frenatus.
Apsylla cistellata.

Chlumetia transversa is widely distributed in India and we have examples from various localities south of the United Provinces. The larvæ bore into the shoots and sometimes feed on the leaves and inflorescence. It is usually a minor pest but is reported as a bad pest of young grafted mangoes at Poona, boring the shoots. Occasionally it occurs on *litchi* also. The only possible control seems to be the prompt removal and destruction of attacked shoots.

Anarsia melanoplecta [Entomological Note 78, Bulletin 59] burrows in young mango shoots, but is not common as a rule and scarcely a pest. There is also a larva which burrows under the bark of mango twigs so that the upper surface of the bark becomes detached and loose and peels off; it is not quite certain whether this is due to *Anarsia melanoplecta* or not.

Damage caused by loose bark in that way is common. **Mr. Ghosh.**

Alcides frenatus [Entomological Note 28, fig. 4] was reported from Dacca as doing considerable damage by boring into shoots of grafted mango trees. **Mr. Fletcher.**

Alcides frenatus at Dacca is a bad pest of regular occurrence in the young shoots of small and large mango trees. Grafted trees suffer more from the attack of this weevil. As regards the lifehistory, almost all the stages are found in the shoots, which die back. The affected shoots are readily distinguishable and picked off, and the beetles, which are commonly found in pairs ovipositing in the shoots, can also be collected. The pest is bad from March to October. **Mr. P. C. Sen.**

Apsylla cistellata ["Indian Insect Life," p. 742, figs. 514, 515] is found throughout Northern India. Its early stages are passed inside a young shoot which becomes distorted and transformed into a curiously-shaped gall. It is not common as a rule, but occasionally becomes a pest in gardens. **Mr. Fletcher.**

The gall assumes the shape of a cone inside which the nymphs are found. The nymphs are covered with a sort of a white powder and the interior of the gall is filled with pearly drops of liquid. **Mr. Ghosh.**

The flowers of mango are attacked by numerous insects of which the most important are the species of *Idiocerus*. On the flowers we get :— **Mr. Fletcher.**

Euproctis scintillans.
Dichocrocis punctiferalis.
Eublemma silicula.
Antestia cruciata.
Idiocerus atkinsoni.
,, *niveosparsus.*
,, *clypealis.*

Euproctis scintillans ["South Indian Insects," p. 399, fig. 268] is sometimes found on mango flowers and has been reported from Saidapet, in Madras, but it is unimportant and not a regular pest.

Dichocrocis punctiferalis [*l.c.*, p. 433, tab. 34] has been bred in some numbers from mango inflorescence and may be considered a minor

pest in this connection. We have already considered this species under castor, but it has a very wide range of foodplants.

Eublemma silicula has been reared at Pusa from mango buds and inflorescence and also at Nagpur from mango flowers. It has also been bred from castor fruit and *juar* heads, but is not known to be a regular pest and may be a rubbish-feeder.

Antestia cruciata [" South Indian Insects," p. 472, fig. 350] has been reported on mango flowers in the Central Provinces, but we do not know what damage is done. It is probably a mere casual visitor on mango.

Idiocerus niveosparsus is described and figured in " South Indian Insects, " pp. 495-496, fig. 384, but *I. atkinsoni* and *I. clypealis* are also common species and quite similar as regards habits, damage and control, so we may consider all three together. Some work has been done recently on these insects in Madras, the Punjab and Mysore, so perhaps the delegates from those Provinces will tell us about this.

In Madras, *Idiocerus niveosparsus* is the species found most frequently as a pest, but the other two species, *I. atkinsoni* and *I. clypealis* are also very common. Experiments on the control of *Idiocerus* have been carried out at Salem, and the results of the first year's work were published in the *Agricultural Journal of India.*

Idiocerus is generally found at the time of the flowering of the mango trees. At other seasons also they are present, but not in large numbers.

One year when I was at Guindy in August there were very large numbers of *Idiocerus* present on the trunks and under sides of the branches of mango trees.

They attack the tender flower-shoots and leaf-shoots, the result being that flower-buds, which appear in the beginning of the season, wither away.

Crude Oil Emulsion was tried from the time the flower-shoots appeared. The trees were sprayed once in every ten or twelve days. The worst trees did not require more than seven or eight sprayings. Some trees were cleared of *Idiocerus* after two or three sprayings.

Two blocks were selected ; one was sprayed, and the other kept as a check. The yields of the two blocks were compared and the results were found to be pretty encouraging.

Last year (1916) Fish-oil-Resin Soap and Crude Oil Emulsion were tried to compare relative cost and efficacy. Fish-oil-Resin Soap was used at a strength of one pound to ten gallons of water, and Crude Oil Emulsion also at the same strength. The cost of Fish-oil-Resin Soap came to eight annas per tree for complete operations, that of Crude

Oil Emulsion to twelve annas. Fish-oil-Resin Soap is more effective and cheaper than Crude Oil Emulsion.

Mr. Fletcher. The relative cost will depend largely on the freight charges. The Fish-oil Soap is made in Malabar, whereas the Crude Oil Emulsion has to be got from Calcutta. In any case, eight annas per tree seems rather expensive.

Mr. Ramakrishna Ayyar. The cost is very gladly borne by the owners of the trees, because the crop is very valuable.

Mr. Fletcher. What sort of sized trees were these ? How far were they apart ?

Mr. Ramakrishna Ayyar. The trees are ten to twelve feet apart, and twenty to twenty-five feet apart in some cases. Spraying is practicable in groves where the trees are not very big and the crop is valuable.

Mr. Fletcher. What items are included in the estimate of cost ? The cost will vary greatly with the labour required, as, for instance, if water has to be brought from any distance.

Mr. Ramakrishna Ayyar. Nothing was included on account of labour charges, as the labour was provided by the gardeners, who were employed in these gardens in any case and were detailed to do this work. The estimate only includes cost of the insecticides used.

Mr. Fletcher. Will you tell us about your experiments with *Idiocerus* in the Punjab ?

Mr. M. M. Lal. In the Punjab experiments against mango-hoppers were carried out at Hoshiarpur. We tried three methods: (1) spraying with Fish-oil-Resin Soap and (2) with Crude Oil Emulsion, and (3) smoking the hoppers out by lighting smoky fires under the affected trees. Of these Fish-oil-Resin Soap was found very effective ; when used at a strength of one pound in 15 gallons, the hoppers were killed. Crude Oil Emulsion was effective when used at a strength of one pound in eight or nine gallons of water. Smoking did not seem to have any good effect ; only the winged hoppers left the trees temporarily.

Spraying was continued until the fruits had set. The fruit on the sprayed trees set very well but in the surrounding areas the trees did not bear any fruit. Later on, the young fruits were attacked by these hoppers and many fruits dropped off the trees.

The experiments are being repeated this year.

Mr. Kunhi Kannan. The Mysore Agricultural Department has suggested to take a large screen smeared with a sticky substance and carry it about, driving the hoppers from the trees, so that they will stick to the screen. This should be done early in the season.

Mr. Fletcher. That method does not seem to be very practicable. I should not care to try to carry about a large sticky screen on a windy day.

In Bombay, Incosopol was tried against mango-hoppers. Thirty-six mango trees were sprayed just when they were coming into flower. Three sprayings were given in all, a wheeled sprayer being used for the purpose, and the insecticide used at a strength of one pound to ten to fifteen gallons of water. The sprayed trees yielded 3,000 to 4,000 fruits and this yield was decidedly much more than that of the unsprayed trees. The cost of three sprayings came to three to four annas per tree, including labour charges.

Spraying is effective provided that it is started soon enough and carried on sufficiently. As regards the best material to use, this is probably largely a matter of local cost. The Fish-oil-Resin Soap, obtainable in Malabar, is the cheapest in Madras; further away, the cost of freight will add to the price. Crude Oil Emulsion requires to be used fairly strong, one part in 25 to 30 of water. Mr. Ramakrishna Ayyar told us that he used it at a strength of 1 part in 100 of water and possibly that accounts for its lessened efficiency as compared with the Fish-oil-Resin mixture. Incosopol, used in Bombay, is a new insecticide prepared by the Indian Cotton Seed Oil Company at Navsari, near Surat. It requires to be tested before we can recommend it, but it is probable that a vegetable oil preparation will be less harmful to foliage than a mineral-oil mixture such as Crude Oil Emulsion. The question of local cost also comes in and what may be cheaper in one district may be more expensive in another. Sprayings require to be repeated because the sprayed trees may be reinfected and because the eggs and some hoppers may escape the effects of one spraying. The life-cycle of *Idiocerus* is extraordinarily short, something like eight or nine days.

The hoppers are found throughout the year. It is only at the flowering-season of the mango that they have opportunities of multiplying very quickly. From the time of hatching to the adult state the bug takes seven to nine days. At the flowering-season, on account of the abundance of tender stems and shoots, they multiply quickly and their number rapidly increases, and that is why such large numbers are found at that time. At other times of the year they breed, but only on tender leaves when these are available, and therefore their numbers cannot increase very much.

We seem to know very little about any natural checks on the increase of *Idiocerus*. We do not know of any parasites and, if there are any, they do not seem very effective.

In Mysore I have found a small moth whose caterpillar parasitizes *Idiocerus* [*exhibited*].

It is quite a novelty and appears to be an Epipyropid. It is evidently a new species and probably belongs to a new genus.

We will go on to the pests of mango fruits. We have :—

Cryptorhynchus mangiferæ.
,, *gravis.*
,, *poricollis.*
Chætodacus ferrugineus.
,, *zonatus.*
,, *correctus.*
Nephopteryx sp.

Cryptorhynchus mangiferæ ["South Indian Insects," p. 341, fig. 200] is common throughout Southern India and sometimes practically all the fruits contain larvæ of this species. The larva feeds on the contents of the mango stone, and pupates inside the stone, the weevil boring its way out. As a rule the weevil does not emerge until after the fruit is ripe, so that the fruits are very little spoilt for eating purposes.

C. mangiferæ has a very wide distribution, having been recorded from India, Ceylon, Java, Chagos Islands, Mauritius, Réunion, Madagascar, Zanzibar, Natal and Hawaii. In India it seems to occur chiefly in the South, and we also have a specimen from Rangoon. It is, of course, very easily distributed with ripe fruit and may be carried all over India in this way; we have, for example, a specimen from Lahore, but it was found in imported fruit and may have come from a long distance.

Cryptorhynchus gravis we know from Rangpur in Bengal, Silchar in Assam, and Maymyo in Burma and we also have a specimen taken at Pusa "on *Bombax* stem." It apparently replaces *C. mangiferæ* in North-Eastern India and is said to be a bad pest in Bengal. It does not seem to occur in mango fruits at Pusa.

Mr. Shroff. At Maymyo in Burma, the mango trees in the Government Gardens are badly affected by *C. gravis*. The grubs are heavily parasitized. The attacked mangoes do not ripen well; sometimes they fall off prematurely.

Mr. Fletcher. *Cryptorhynchus poricollis* is referred to in Entomological Note 28 in Bulletin 59. It seems to be confined to Bengal.

Mr. P. C. Sen. A *Cryptorhynchus*, which may be *C. poricollis*, is a bad pest in Dacca and throughout Eastern Bengal and Assam, and sometimes the whole crop is spoilt. The grub and pupa are found inside the pulp of the fruit and not in the stone as in the case of *C. mangiferæ*. This point may be confirmed by cutting open green fruits when the grubs will be found in the pulp. The grubs are found from May to August. This pest is not bad in young plants but the attack is very serious in the case of older trees.

At Maymyo, in Burma, a yellow beetle was found in large numbers on one occasion only attacking green fruits.

Chætodacus ferrugineus in its various forms (*ferrugineus*, *dorsalis*, *incisus*, and *versicolor*) is probably the commonest Fruitfly of the mango in India and Burma and also breeds in guava, loquat, peach, pomelo, *Solanum*, *Capsicum*, jak-fruit and various other fruits. The Fruit-flies of this group have just been revised, and all the available information on the species occurring in India, Burma and Ceylon has been given by Professor Bezzi in the latest number of the *Bulletin of Entomological Research* [Vol. VII, pp. 99-121; October 1916], so we need not go into this group very closely now, and as regards control we will come to that under peach.

Chætodacus zonatus is the species hitherto called *persicæ* and *mangiferæ* in India. It is usually a peach pest but has been bred from mango fruits also. It is widely distributed in India.

Chætodacus correctus was reared from mango fruit at Coimbatore and is also known from Pusa (in peach), Hagari and Guindy. The specimens collected by me at Guindy were attracted to an opened termitarium but there were mango trees quite close and they probably came from them. The smell of the earth in a newly opened termitarium attracts numerous flies but I do not remember to have seen Fruitflies attracted before. There has of course been a good deal of literature on the attraction of Fruitflies by the smell of citronella, kerosine oil and other oils; but it is only the males that are attracted and such methods are useless for control.

Fruitflies are very bad in mango fruits in Madras.

On one occasion at Coimbatore, whilst trying remedial measures against *Batocera* and other pests, roots of mango trees had to be exposed and were cut in some cases. The cut roots were found to attract a very large number of Fruitflies belonging to a species which usually attacks the fruits.

A species of *Nephopteryx* was found boring green mango fruits at Bombay in February 1911, but we have only had it once and do not know any more about it as a pest.

The next group of pests of mango includes those insects found boring into the stem, branches and bark of the tree.

Arbela tetraonis.
Batocera rubus.
Acanthophorus serraticornis.
Belionota prasina.
Unnamed Cerambycid beetle.
Termites.

Arbela tetraonis ["South Indian Insects," pp. 453-454, tab. 41] occurs in most parts of India, but it is probable that *A. quadrinotata* is often confused with *tetraonis*. The life-history is described in my book and control was discussed under *Citrus*. It is not a serious pest of mango as a rule and fairly conspicuous and easily dealt with when it occurs, so that little damage should be done in any well-kept orchard.

Batocera rubus [*l.c.*, p. 324, fig. 179] occurs commonly in mango in Southern India; in Northern India it seems to prefer fig trees but sometimes does damage to mango also.

Acanthophorus serraticornis [*l.c.*, p. 320, fig. 173] is said to bore in mango, but we seem to have little information about it.

Belionota prasina usually bores in guava, I think, but sometimes occurs in mango. It has been recorded as boring in mango trees at Chicacole [see Stebbing, *Indian Forest Coleoptera*, pp. 217-218]. It is not known as a regular pest of mango.

An unnamed Cerambycid is recorded as a minor pest of mango at Thaton, in Burma. It is perhaps *Rhytidodera robusta*. [Gahan, *Fauna of India, Cerambycidæ*, Vol. I, p. 147, fig. 59.]

Termites, usually species of *Odontotermes*, sometimes attack mango trees, usually gnawing the bark under cover of a sheet of mud. At Coimbatore I found a mixture of Crude Oil Emulsion and Tar, half and half, painted in bands around the tree, fairly effective to keep termites away.

As regards the boring pests, a mixture of creosote and chloroform, or carbon bisulphide, or similar liquids, can be syringed in when the galleries are visible. In other cases the only remedy is to cut them out and tar the cut surface.

Mr. Ramakrishna Ayyar. At Coimbatore syringing with creosote and chloroform has been found successful in the case of boring insects in mango trees.

Mr. Shroff. In Burma carbon bisulphide was tried with great advantage against borers.

Mr. M. M. Lal. In the Punjab, at Hoshiarpur, there was trouble from borers of sorts and carbon bisulphide injection was found successful.

Mr. Fletcher The next and last group of insect pests of mango includes the sucking insects. We have already taken *Idiocerus* spp., *Antestia cruciata* and *Apsylla cistellata* and the remaining insects are mostly Scales and are not very important pests on the whole.

Aleyrodes sp.
Monophlebus stebbingi octocaudatus.
Icerya seychellarum.
,, *minor.*
Pseudococcus (*Dactylopius*) sp.

Pulvinaria psidii.
Ceroplastes floridensis.
Vinsonia stellifera.
Coccus mangiferæ.
Chionaspis dilatata.
,, *vitis.*
Leucaspis indica.
Aspidiotus destructor.
,, *trilobitiformis.*
Parlatoria pergandii.

Aleyrodes sp. An unidentified species has been found on mango but is not known as a pest.

Monophlebus stebbingi var. *octocaudatus* occurs every year at Pusa from January to May and attacks all fruit trees, massing on the young shoots. It is not a special pest of mango but may sometimes be a pest of this tree when it is in numbers. The eggs are laid in the ground about May and remain there until they hatch out about November-December. Digging around the trees to destroy the eggs and banding the trees when sufficiently valuable, to prevent the young bugs from crawling up, will reduce damage. A layer of fine sand around the tree makes an effectual barrier so long as its surface remains dry and loose.

Icerya seychellarum has been recorded on mango at Poona but is not common and not known as a pest of mango.

Icerya minor [Entomological Memoirs, II, 17-18] is found on mango leaves at Pusa commonly but is not a pest.

Pseudococcus (*Dactylopius*) sp. occurs in Madras but is not serious as a pest.

Pulvinaria psidii ["South Indian Insects," p. 511, fig. 399] occurs commonly on mango in most districts but is not a bad pest as a rule.

Ceroplastes floridensis has been found on mango but is not known as a pest.

Vinsonia stellifera is found commonly on mango, especially in Madras, but is not a pest.

Coccus (*Lecanium*) *mangiferæ* has been found on mango at Pusa, but not as a pest.

Chionaspis dilatata has been recorded on mango at Poona; it is of common occurrence on both surfaces of the leaves. Also found on palms at Calcutta.

Chionaspis vitis is said to be a bad pest of mango in Madras, but we know little about it.

Leucaspis indica has been recorded from Poona as occurring commonly on mango trees. "The scales are completely hidden under the

black mould so common in connection with Scale insects, but under this covering the scales completely encircle the tender branches. It may become a serious pest if not carefully watched." [*Bombay Journal* XXIII, 135.] This is an excellent example of our want of knowledge of Indian Coccidæ, this species being first identified in America on young mango trees imported from India.

Aspidiotus destructor ["South Indian Insects," p. 518, fig. 408] is generally bad on palms and occasionally occurs on mango but is not usually a bad pest on mango.

Aspidiotus trilobitiformis is also on our list of Scales from mango but otherwise we know little about it.

Parlatoria pergandii has been recorded on mango in Rajputana but does not appear to be a pest.

The list of Coccids on mango in India is very small, and our information about them still more meagre, and a little search would doubtless extend both very considerably. Few Coccids, however, seem to be really bad pests of mango and when treatment is required a contact insecticide spray containing resin will usually be effective.

LITCHI (*Nephelium litchi*).

On the leaves of *litchi* we get :—

Eriophyes sp.
Selepa celtis.
Thalassodes quadraria.
Argyroploce leucaspis.
,, *aprobola.*
Œcophylla smaragdina.

Eriophyes is the mite which produces a curious malformation of the leaves. It was fully described by Mr. Misra in the *Agricultural Journal of India* [Vol. VII, pp. 286-293, figs.] in 1912 and there is no more to add to that. The leaves curl up and become thickly covered with a brownish velvety pubescence. Removal of infested leaves and spraying with Crude Oil Emulsion and Flowers of Sulphur has been found to provide effective control.

Selepa (Plotheia) celtis ["Indian Insect Life," p. 449, fig. 308] occurs throughout India and Burma as a sporadic pest of *litchi*. It is also found on mango, rose, *Terminalia*, *Gmelina* and various other trees.

Thalassodes quadraria is usually found in small numbers only on litchi and has been reared on this at Pusa and Poona.

Argyroploce leucaspis is widely distributed in India, Burma and Ceylon and has been reared at Pusa in some numbers from larvæ rolling litchi leaves, but is scarcely a pest.

Argyroploce aprobola is also widely distributed throughout the Plains and is a very minor pest of litchi, the larva rolling the leaves. It has also been reared at Coimbatore from larva boring rose-bud, at Poona, Pusa and Bassein Fort on mango, and at Pusa on rose flower and leaves of *Cassia tora* and *Polyalthia longifolia*.

Œcophylla smaragdina nests in litchi trees in the same way as it does in mangoes and is equally a nuisance to the fruit-pluckers.

Litchi fruits are rather free of insect pests but are occasionally attacked by the caterpillar of *Argyroploce illepida* ["South Indian Insects," pp. 449-450, fig. 327], which bores in the interior of the stone. It has a very wide range of food-plants, having been reared from *Cassia fistula* pods, *Acacia arabica* pods, *agathi* pods, wood apple (*Feronia elephantum*), *bael* (*Ægle marmelos*) fruit, etc. The damage done is small and no control seems possible.

I remember to have reared Fruitflies from litchi fruits at Pusa, but I cannot say what species it was.

I have never seen Fruitflies myself in litchi fruits and they must be scarce in this fruit.

Boring in the stem of litchi we find *Arbela tetraonis*, which is not an uncommon pest of litchi in Bihar. The caterpillars are fairly easily dealt with, as we saw under mango.

The sucking insects found on litchi include :—

Tessarotoma quadraria.
Tachardia albizziæ.
Saissetia (Lecanium) nigra.
Pulvinaria psidii.

Tessaratoma quadraria was reported on litchi in numbers at Kalimpong in 1914, but we do not know it otherwise as a pest.

Tachardia albizziæ is a lac-insect sometimes found encrusting litchi branches in masses. I do not know whether it occurs in India, where I have never seen it myself, but I saw some very fine examples of this insect when I was at Peradeniya in April 1914, large branches of litchi being thickly encrusted with this Scale.

Saissetia (Lecanium) nigra occurs on the leaves and occasionally on the fruit, but it is usually quite a minor pest on litchi.

Pulvinaria psidii also occurs at times but is not much of a pest as a rule.

Probably other Scales occur also and the fact that we do not know about them affords perhaps the best testimony that they are not of any great importance as pests.

GUAVA (*Psidium guyava*).

The leaves of guava are rather free from attack by leaf-eating pests. A few weevils occur, of which *Myllocerus discolor*, *M. sabulosus* and *M. 11-pustulatus* have been noticed at Pusa and *M. viridanus* at Palur, but they are of no great importance.

Insects boring in the stem of guava trees include :—

Arbela tetraonis.
Belionota prasina.

Arbela tetraonis has already been considered under *Citrus*. It is a fairly frequent pest of guava also, and control is similar.

Mr. Jhaveri. *Arbela* is a common pest of guava in Gujarat. For control the larval webbings on the trunk are removed and a wad of cotton moistened with carbon bisulphide is thrust into the larval gallery; this treatment is quite effective. An injection of kerosine oil was also tried in some cases but found not quite so effective; the kerosine oil did not injure the trees.

Mr. Fletcher. *Belionota prasina* is also found boring in guava trees. It used to be fairly common in Pusa but does not seem to occur so frequently nowadays. The beetles appear at Pusa about August-September. It is known to occur in mango also and probably has a fairly wide range of foodplants.

Guava fruits are attacked by :—

Virachola isocrates.
Dichocrocis punctiferalis.
Chætodacus ferrugineus.

Virachola isocrates and *Dichocrocis punctiferalis* are found, although rarely, boring in the fruits and are not pests of guava.

Chætodacus ferrugineus in its various forms has been bred from guava fruits but is not very common as a rule and scarcely a pest.

The sucking insects found on guava are all Scales and some are serious pests.

Monophlebus stebbingi octocaudatus.
Pulvinaria psidii.
Coccus viridis.
Saissetia (Lecanium) hemisphærica.
Chrysomphalus (Aspidiotus) rossi.
Aspidiotus lataniæ.

Monophlebus stebbingi octocaudatus is common on guava, as on most trees, at Pusa and probably throughout Northern India. We discussed control under mango.

Pulvinaria psidii is often a bad pest of guava and is almost always present when any number of guava trees are grown. When it is bad it is best controlled by spraying with Fish-oil-Resin Soap but two or three applications will be required at intervals of ten or twelve days.

Coccus viridis also occurs on guava but does not seem to be a bad pest in India. However, guava is a regular foodplant and there is considerable danger of introducing this Scale into new districts with imported guava plants.

Saissetia (*Lecanium*) *hemisphærica* is also common on guava but not a bad pest as a rule.

Saissetia hemisphærica is bad on guava in Kollegal.

Chrysomphalus rossi and *Aspidiotus lataniæ* both occur on guava but are not serious pests.

POMEGRANATE (*Punica granatum*).

The leaves of pomegranate are eaten by a few insects but these are not serious pests, at least as a rule.

Achæa janata.
Parasa lepida.
Euproctis flava.
,, *fraterna.*
Myllocerus 11-pustulatus.

Achæa janata and *Parasa lepida* both occur on pomegranate at times and it is worth while remembering that this plant can be an alternative foodplant for these caterpillars.

Euproctis flava has been recorded from the Punjab and *E. fraterna* from Madras, and both these species are sporadically abundant.

Myllocerus 11-pustulatus occurs on the leaves of pomegranate as on nearly all other plants, but is scarcely a pest.

The fruits of pomegranate are usually the parts most liable to attack and may be very badly damaged at times. The following pests are known :—

Virachola isocrates.
Deudorix epijarbas.
Mealy-bug.

Virachola isocrates has been described in "South Indian Insects." p. 416, fig. 289, and a coloured plate showing the life-history has since been issued. The caterpillar bores in the fruit and destroys it. It also feeds in guava, loquat, tamarind, wood-apple (*Feronia*) and orange but its main foodplant is pomegranate and it is decidedly the worst pest of this fruit in the Plains or at least, in most parts of the Plains.

Virachola isocrates, Fb.

Fig. 1. An egg (magnified).

Fig. 2. A fruit showing two eggs on it and a hole through which the young caterpillar has gone in.

Fig. 3. A flower with two eggs on it.

Fig. 4. A damaged fruit with a nearly full-grown caterpillar on it.

Fig. 5. Full-grown caterpillar, dorsal view (magnified).

Fig. 6. A damaged fruit cut open showing pupa inside.

Fig. 7. A pupa (magnified).

Fig. 8. Butterfly in repose.

Fig. 9. Female butterfly with wings expanded, wings on the right those of a male (both magnified)

VIRACHOLA ISOCRATES.

for in the North-West Frontier Province I do not know of its occurrence at all. Control is difficult as the caterpillar feeds inside the fruit. Destruction of attacked fruit is an obvious measure to take, but this means the destruction of practically the whole crop in many cases. The catching of the female butterflies in hand-nets is not at all easy, as the flight is swift. The covering of the flower branches with bags might be tried in the case of especially valuable varieties; the eggs are often laid on the young flowers, so that the mere bagging of fruits would be too late to be effective. Diligent attention will enable the eggs to be found and destroyed but even with this method many escape detection and it is not a method likely to be adopted by the average cultivator.

Virachola isocrates is very bad at Pusa, sometimes 75 per cent. of pomegranate fruits being affected. **Mr. Ghosh.**

In the Punjab *Virachola* is found but little damage is done to pomegranate fruits. **Mr. M. M. Lal.**

As regards control, in 1909 we tried netting the small fruits at Ganeshkhind Botanical Garden, Poona. The bagged fruits were saved. **Mr. Jhaveri.**

Tying the fruits in muslin bags is not so successful, as the eggs are laid on flowers also and even on adjacent leaves. If this trouble can be undertaken, looking over the flowers and fruits and rubbing off the eggs, once in every three days, is quite effective. **Mr. Ghosh.**

The caterpillar is found in the fruit just below the rind and keeps a hole in the rind for disposal of frass: it plugs this hole with its tail end and so can easily be pricked with a pin or thorn. This will kill the caterpillar but will not save the fruit. **Mr. Fletcher.**

Deudorix epijarbas is recorded by Hannyngton [*Bombay Journal* XX, 369-370] as destructive to pomegranate fruits in Kumaun in June and July, so that " in some years scarcely a pomegranate escapes their attacks." It is curious that *D. epijarbas* has never been sent in to us as a pest.

A Mealy-bug is found at Coimbatore under the distal projection on the fruits and on fruit stalks. It seems to occur in most districts but is scarcely a pest, doing little harm as a rule.

The sucking insects on pomegranate include :—

Aleyrodes sp.
Chrysomphalus (*Aspidiotus*) *rossi*.
Aspidiotus orientalis.

A small white *Aleyrodid*, very like *Dialeurodes citri* but apparently distinct, sometimes occurs abundantly on pomegranate but its occurrence is sporadic. When I was at Dharwar in February 1912 some pomegranate trees there were covered with this Aleyrodid, which flew

out in clouds when the leaves were disturbed; but a subsequent visit failed to reveal a single example.

This Aleyrodid also occurs at times at Coimbatore and Bangalore.

It occurs in the Punjab also, but is not very extensively found—only small colonies here and there.

Chrysomphalus (*Aspidiotus*) *rossi* and *Aspidiotus orientalis* have been found on pomegranate at Bilaspur but are apparently not regular pests. Indeed, pomegranate seems to be rather free of real pests with the important exception of *Virachola isocrates* and sporadic outbreaks of the white Aleyrodid.

WOOD-APPLE (*Feronia elephantum*).

The leaves are occasionally stripped by larvæ of *Parasa lepida* and the fruits afford alternative food for larvæ of *Argyroploce illepida* and *Virachola isocrates*.

GRAPE-VINE (*Vitis vinifera*).

The leaves of the vine are attacked, sometimes badly, by various leaf-eating insects :—

Brahmina coriacea.
Adoretus lasiopygus.
.. *versutus.*
.. *duvauceli.*
.. *horticola.*
Scelodonta strigicollis.
Myllocerus sp.
Hippotion celerio.
Theretra alecto.
Sylepta lunalis.
Phyllocnistis toparcha.
Teratodes monticollis.

Brahmina coriacea, *Adoretus lasiopygus*, *A. versutus* and *A. horticola* all occur on vine-leaves and may do considerable damage in localities where these beetles are abundant. The damage is done by the adult beetles eating the leaves. [See Entomological Notes 14, 18, 20, 21 and 22 in Bulletin 59.]

Scelodonta strigicollis ["South Indian Insects," p. 309, fig. 158] is common on vines throughout India and Burma and often does serious damage. The beetles may be collected in numbers off the leaves by means of hand-nets or the plants may be sprayed with a stomach-poison. There is also a local control-method described in *Agricultural*

Journal of India, Vol. II, p. 292. The life-history does not seem to be known, but it is found commonly on wild species of *Vitis*.

In the North-West Frontier Province *Scelodonta strigicollis* destroys the tender shoots of grape-vines. As regards control, (1) collecting the beetles by tapping the creepers, (2) pruning long (*i.e.*, leaving three or four buds remaining instead of one or two), and (3) removing all the loose bark, have been found useful measures. **Mr. Robertson-Brown.**

The method, described in the *Agricultural Journal*, of control by plantain brooms, is generally practised in Nasik. **Mr. Jhaveri.**

Species of *Myllocerus* are found on vine leaves, sometimes in numbers, but are scarcely pests. **Mr. Fletcher.**

Hippotion celerio is a widely-distributed species which is recorded as a pest of the grape-vine in Australia. In India it is a minor pest in most districts.

Theretra alecto has been reared at Pusa on grape-vine, a wild *Vitis*, and on *Boerhaavia* but is not known to be a pest.

Sylepta lunalis occurs throughout India, Burma and Ceylon and has been reared in Bihar from larvæ rolling grape-vine leaves into a funnel and dropping to the ground on the least disturbance. It is a minor pest of the vine.

Phyllocnistis toparcha is so far only known from Madras where it mines the leaves of the vine much in the same way as *P. citrella* mines in *Citrus*. This is a novelty, only found last year and described quite recently.

It is found at Coimbatore and is common on vine there. **Mr. Ramakrishna Ayyar.**

Teratodes monticollis [" Indian Insect Life," p. 88, figs. 28, 29] was sent in to us from Bengal as attacking vine leaves, but only one specimen was sent and that was probably a mere casual visitor or feeder. It is not known as a pest of grape-vine. **Mr. Fletcher.**

The stems and branches of vine are attacked at times by *Sthenias grisator* which rings them in much the same way as it attacks *Erythrina*. It has been reported from Palitana as doing this. The adult beetles may be collected on the plants and the ringed portion destroyed by fire.

The fruits are rather immune from attack but Noctuid moths have been reported to suck them at Lyallpur.

The moths found were identified at Pusa as *Achæa janata*, *Ophideres fullonica* and *Anua coronata*. They did serious damage last year at Lyallpur by puncturing the fruits, which afterwards rotted as a result. **Mr. M. M. Lal.**

Ophideres fullonica is a well-known pest of fruits and we discussed it under *Citrus*. It is possible that the other two species were only **Mr. Fletcher.**

feeding on the fruits punctured by *Ophideres*; an examination of their proboscides wou'd settle this point. Probably a good many Noctuid moths have a dental armature on the proboscis; this is the case not only in *Ophideres*, but also in *Calpe* and *Earias*.

Scutellera nobilis was recorded [*Indian Museum Notes*, V, iii 119] as attacking grape fruits at Siripur Farm, Hutwa. We do not know it otherwise as a pest.

The sucking insects found on vine include :—

Typhlocyba spp.
Chrysomphalus (*Aspidiotus*) *aonidum* (*ficus*).
Pulvinaria sp.
Parlatoria pergandei camelliæ.
Thrips.
Mites.

Typhlocyba, probably of more than one species, is very abundant on grape vine in the Peshawar Valley. Specimens were sent to Mr. Distant but were not included in the latest supplement to his *Fauna* volume. With the help of a hand-net it is possible to collect a large number from the leaves but this method is hardly practicable as a control. Spraying is difficult on account of the density of the leaves.

In the lower parts of the Peshawar Valley the damage from vine-hoppers is so severe that no vines can be grown there. In the Upper Valley no damage is done by these hoppers. The pest is bad only where there is plenty of moisture. Nothing is done to check the pest.

Chrysomphalus aonidum (*ficus*) occurs at Coimbatore and is sometimes bad on growing stems.

A species of *Pulvinaria* occurs at Salem and is a serious pest of the shoots and stems.

Parlatoria pergandei camelliæ has been reported from Bangalore.

Thrips sometimes do damage to young leaves of vine in Madras, the attacked leaves curling up, but the damage is done chiefly to stray plants so that this is not a bad pest.

Mites also occur on vine leaves but do not seem to have been noted as doing any great damage.

At Raipur termites have been found damaging the plants by attacking the roots.

In the case of garden-cultivated plants such as vines control by watering with a deterrent should be easy.

PINEAPPLE (*Ananas sativa*).

We do not seem to know of any insect pests of pine-apple in India. I remember seeing some plants infested with a woolly-scale, probably

a *Pseudococcus*, but I am not certain whether this was in India or not; it was a long time ago and I rather think it must have been in the Seychelles.

PLANTAIN; BANANA (*Musa sapientum*).

Plantains of various varieties are grown practically throughout our limits and are attacked by various pests of which the most serious are the stem-borers. **Mr. Fletcher.**

On the leaves we get :—

Diacrisia obliqua.
Pericallia ricini.
Prodenia litura.
Parasa lepida.
Nodostoma subcostata.

Diacrisia obliqua occasionally occurs on plantain leaves in Bihar and Bengal, but is scarcely a pest. The young larvæ may be collected whilst gregarious, and destroyed.

Pericallia ricini is occasionally found on plantain, chiefly in Madras. The larvæ may be collected and destroyed.

Prodenia litura has also been found at times on plantain leaves but this is an unusual foodplant.

In the Central Provinces *Prodenia litura* occurs on plantain leaves. **Mr. Ratiram.**

Parasa lepida occurs on plantain not uncommonly and the larvæ being sluggish, seem to remain in one place and eat large holes and patches in the leaves. The attack is thus conspicuous and the larvæ easily found and killed, care being taken not to handle them. I saw some plantains quite badly attacked by this species near Virajpet in Coorg in October 1915. **Mr. Fletcher.**

Nodostoma subcostata is a small Chrysomelid beetle which seems to have a curiously restricted distribution as a pest, as it does not seem to have been noticed outside of Pusa, although it is recorded by Jacoby [*Fauna of India, Chrysomelidæ*, p. 334] from Assam and Burma. At Pusa it is common and eats patches in the leaves in quite a conspicuous manner. It also attacks the skin of young fruits whose appearance is spoilt for the market as they are covered with black patches. In the case of gardens spraying is practicable and also catching of the beetles in hand-nets. In the case of a small number of plants it is possible to check the pest by killing the beetles by hand when they are found in the central leaf-funnel. We should like to know whether this insect does not occur on plantains also in Bengal, Assam and Burma.

Apart from the unsightly patches produced by the beetle on the fruits, I believe it spoils the taste of the fruit also to some extent, the flavour being lost.

Boring in the stem and roots we get three weevils :—

Odoiporus longicollis.

Cosmopolites sordidus.

Polytes mellerborgii.

Odoiporus longicollis is a serious pest of plantain in North-East India and Burma. We have examples of the typical form from Pusa, Munshiganj, Jorhat, and the Buxar Duars and of the form *planipennis* from Munshiganj, Buxar Duars, Halem (Assam) and Maymyo (Burma). The larvæ bore in the stem so that the whole plant dies off and the only satisfactory control is the prompt destruction of affected plants which will be destroyed when attacked in any case.

The life-history has been worked out in the Pusa Insectary and a coloured plate of this species was issued last year. The actual life-cycle from egg to adult is comparatively short, a couple of months or so, but the adult beetles are extraordinarily long-lived and some lived in the Insectary for a period of two years.

At Pusa *Odoiporus longicollis* is found practically all the year round. The grubs riddle the whole tree. The beetles take six to eight weeks for one cycle and the adults live for nearly two years. They generally remain under the sheathing leaves and feed there. As regards control, the beetles are not attracted to old stumps and are sluggish. Timely removal and destruction of affected trees checks its spread effectively.

Odoiporus longicollis was found at Dacca Farm on one occasion, when the attack was bad.

Cosmopolites sordidus bores low down in the stem and especially in the root-stock. It is described and figured in "South Indian Insects," pp. 342-343, fig. 201, and I do not think we have much to add to the account given there. In India it occurs throughout Southern India and in Western India as far north as Poona, and is likely to be found in other districts, as it is very likely to be introduced in root-stocks. It has also been recorded from Ceylon, Burma and the Andamans. Outside of India it has a wide distribution, being recorded from the Seychelles, Réunion, Java, Malacca, Saigon, China, Sunda Islands and Fiji, and has doubtless been introduced into many of these localities with its foodplant. In Fiji it has proved a serious pest, so much so that Mr. Jepson, the Entomologist in Fiji, went on special mission to Java in quest of the natural enemies of this weevil. An account of this is given in Bulletin No. 7 of the Fiji Department of Agriculture, and I need

Odoiporus longicollis, Ol.

Fig. 1 is the egg ;

Fig. 2 the full grown grub (magnified) ;

Fig. 3 shows a grub in its natural tunnel in an affected piece of the stem ;

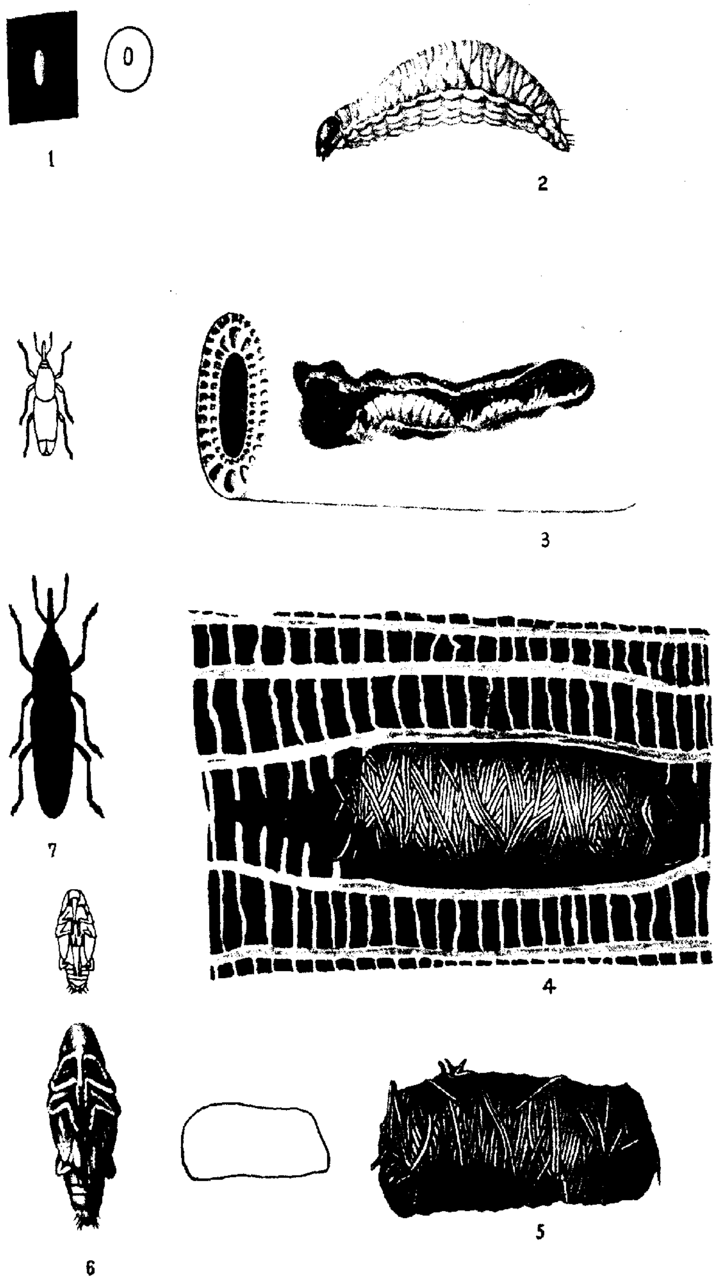
Fig. 4 shows a cocoon in its natural position inside the sheath (magnified) ;

Fig. 5 shows the cocoon separately (magnified) ;

Fig. 6 is the pupa, and

Fig. 7 the adult weevil.

Figures in outline show the natural sizes.



ODOIPORUS LONGICOLLIS.

only say now that a Histerid beetle, *Plœsius javanus*, was found feeding on the weevil larvæ in Java and was successfully transported to Fiji. Whether we have any similar natural enemies in India we do not know. Control is mainly a question of selection of non-infected suckers and careful destruction of old stumps.

Polytus mellerborgii was found at Pusa ten years ago boring in plantain roots but has not been noticed since, so we may assume that it is not a regular pest.

A few sucking insects are found on plantain on the leaves and young shoots.

Stephanitis typicus.
Aphids.
Aspidiotus destructor.
,, *orientalis.*
,, *lataniæ.*

Stephanitis typicus is described and figured in "South Indian Insects," pp. 484-485, fig. 369, and the early stages have since been described and figured in Entomological Note 96, fig. 20, in Bulletin 59. This bug is found almost always on the under-surface of the leaf, which they puncture especially on either side of the mid-rib, producing a characteristic spotty appearance of the leaf, which looks unhealthy. It also occurs on turmeric and a very similar (if not identical) species is found on coconut. It can be controlled by spraying with a contact insecticide.

Aphids sometimes occur on plantains, especially on the young shoots, but are not bad pests as a rule.

Mr. Ramakrishna Ayyar. At Coimbatore Aphids occur on the young shoots but do not do any serious damage.

Mr. Fletcher. *Aspidiotus destructor*, *A. orientalis* and *A. lataniæ* have all been recorded on plantain but Scales are not serious pests of this plant.

PEACH (*Prunus persica*).

The leaves of peach are not usually seriously attacked by leaf-eating insects but are occasionally stripped, especially in the Hill Districts. Amongst leaf-eating pests we know :—

Popillia feæ.
,, *histeroidea.*
Anomala aurora.
,, *pallidospila.*
,, *decorata.*
Emperorrhinus defoliator.

Popillia feæ and *P. histeroidea* have both been found on peach at Maymyo, in Burma, and there is a note on the latter in Entomological Note 24, fig. 3, in Bulletin 59.

Anomala aurora, *A. pallidospila* and *A. decorata* have also been found on peach at Maymyo and the first two are referred to in Entomological Note 14 in Bulletin 59.

Anomala beetles do some damage to peach leaves in Burma.

Emperorrhinus defoliator is a weevil known to occur in Kulu, Darjiling and the Khasi Hills and occasionally defoliating whole orchards of peaches, apricots, pears, etc. It was only described last year by Dr. Marshall from specimens sent from Pusa and Dehra Dun [*Bull. Ent. Res.* VI, 365, fig.; *Fauna of India, Curculionidæ*, I, pp. 286-287].

Peach fruits are attacked by a few insects but great damage is often done.

Calpe ophideroides.
Dichocrocis punctiferalis.
Chætodacus ferrugineus.
,, *zonatus.*
,, *tuberculatus.*
,, *correctus.*
,, *duplicatus.*

Calpe ophideroides presents another interesting case of damage being done by an adult moth. This is described in Entomological Note 64, figs. 9, 10, in Bulletin 59 and we have little more to add.

An inquiry was received by me from the Deputy Commissioner, Attock, regarding moths damaging peach fruits. At the time I was not aware that damage could be done in this way by adult moths but it now seems probable that the damage was really done by Noctuid Moths such as *Calpe ophideroides.*

Dichocrocis punctiferalis has been bred from peach fruits on several occasions. The larva bores into the fruit, generally in the groove along one side of the fruit, and feeds on the fleshy substance of the fruit. So far it has been noted as a curiosity rather than a pest but it might become serious and would be difficult to check.

We now come to the important subject of Fruitflies, of which our present knowledge has just been summarized by Professor Bezzi in his recent timely paper on Indian Fruitflies in the *Bulletin of Entomological Research*. This contains practically all our records to date of the species concerned and of their occurrence in various localities and plants, so we will first go over this information briefly and then consider the general question of control of these flies.

Chætodacus ferrugineus ferrugineus was reared from peach at Myitkyina, Upper Burma, and also occurs in guava, loquat, mango and pomelo and is widely distributed in India, Burma and Ceylon. It does not seem to be an important pest of peach in India.

Chætodacus ferrugineus dorsalis has been reared from peach at Taru, Peshawar District, and at Maymyo in Upper Burma, and is also distributed throughout India, Burma and Ceylon, attacking also loquat, mango, chilli, pomelo, guava, pear and *Solanum verbascifolium*.

Chætodacus zonatus is the species which has been called *persicæ* and *mangiferæ* in India. It is probably the commonest and most destructive of the Fruitflies found in peaches and is known to attack peaches at Ranchi, Pusa, Pachmarhi and Peshawar. It also occurs in Southern India and has also been bred from fig, sapota, ripe *bael* fruit, fruits of *Careya arborea*, mango, and at Nagpur in white gourd (*Lagenaria vulgaris*); but this last record seems a little doubtful and is perhaps a case of mis-labelling.

C. zonatus usually appears at Pusa in the fruits which ripen towards the end of May, becoming worse as the season advances, so that late-ripening fruits may be badly affected. At Peshawar, where the peach season commences about 10th June, there seems to be no trouble with Fruitfly maggots until about the middle of August, but thereafter practically all the fruits are attacked. It would be interesting to have some exact observations on the occurrence of the flies, and the species concerned, in other localities.

Mr. Robertson-Brown. At Peshawar *Chætodacus zonatus* occurs only late in the peach season up to October.

Mr. Fletcher. *Chætodacus tuberculatus* is a new species described by Professor Bezzi in his recent paper. It was bred from peaches from Taung-gyi and Myitkyina, in the Southern Shan States and in North Burma respectively, but is not known to occur outside of Burma.

Chætodacus correctus has been reared from peach at Pusa and also at Coimbatore from mango.

Chætodacus duplicatus is another new species described by Professor Bezzi from examples reared from peach at Pachmarhi, which is its only known locality at present.

It is evident that we want to know more about these Fruitflies as regards the species concerned, their discrimination, life-histories and distribution. Practically everything in the way of a Fruitfly bred from peaches has in the past been lumped together as "*Dacus persicæ*," but we now know that half-a-dozen species are concerned and it is quite possible that this fact may throw a little light on the occasional sporadic appearance of these flies in destructive numbers and also on problems

such as the non-occurrence of Peach-flies in the Peshawar valley during June and July.

We come now to the question of control measures. Speaking generally, the fruits are attacked when about half or two-thirds grown and the maggots mature as the fruit ripens; when full-grown they drop to the ground and wriggle and skip about until they find a suitable place, when they burrow in and pupate. Generally the puparia remain in the ground over the winter, emerging next year when the young peach fruits are ready for attack; but it is possible that in some cases they may lie over for two or more years.

A great deal of work has been done all over the World on the control of Fruitflies and the methods adopted are mainly three in number, (1) attraction and poisoning of adult flies, (2) employment of natural parasites and (3) destruction of larvæ in attacked fruit. As regards these the first is probably the best but it requires foresight in its application and for its successful use we must know when the flies are about and ovipositing and catch them then before they have had an opportunity of doing damage; for it is of very little use, in the case of the present year's crop, to start killing off the flies once the eggs are laid. If, however, we know that fruits, such as peaches, are likely to be attacked and if we know the habits of the fly pest in the locality concerned, we can apply a bait to catch and kill the female flies as soon as they have emerged from their puparia and before they have had time to oviposit on the trees. The bait used is generally a mixture of sugar and water with a little Lead Arsenate and it is sprayed onto the leaves of the trees concerned so that it falls in little droplets which may be sucked up by the female fruitflies when they visit the tree to look for fruit in which to oviposit. We made some experiments at Pusa, in the Insectary, to find what was the best strength to use and whether it was possible to employ Lead Chromate instead of the more poisonous Lead Arsenate; the results were briefly reported in our Report for last year and Mr. Ghosh will give you some further details now.

Parallel experiments with several species of *Chætodacus* were carried out, batches of flies being confined in muslin cages and supplied with sponges dipped in (1) water, (2) *gur* solution, 2½ lb. in four gallons water, (3) Lead Arsenate (Thomsen Chemical Co.) with *gur* solution, (4) Lead Arsenate (D. Waldie) with *gur* solution, (5) Lead Chromate with *gur* solution, and (6) some flies were kept without any food or water. Those kept without any food and those fed with water only, died within two days. Those supplied with *gur* solution lived for periods varying from one to two-and-a-half months. Different strengths of Lead Arsenate, from 5 to 3 ounces in four gallons of *gur* solution, were used in experi-

ments (3) and (4). Experiment (3) gave better results than (4) at equal strengths, the flies in (3) dying within 36 hours whilst those in (4) lived for more than four days. It was found in practice that 3 ounces of Lead Arsenate gave as good results as 5 ounces, so that 3 ounces were used in all later experiments, but the Lead Chromate was used at a strength of 5 ounces in 4 gallons of *gur* solution. In the case of (5) the flies lived for more than a month, so that Lead Chromate is not effective as a poison.

In 1916 a preventive course of spraying was given to peach-trees at Pusa in April, but a practical difficulty was found in the rapid drying up of the droplets of solution.

Mr. Fletcher. Instead of spraying directly onto the leaves, which of course requires to be renewed every few days and immediately after every shower of rain, it is possible to hang up in the trees bundles of twigs or similar traps, dipped in the solution and provided with a tin roof to keep off rain. You will find a general *résumé* of this subject in the *Canadian Entomologist* for 1914 and that may give you some useful hints.

As regards knowing when the flies are about, the attraction of citronella oil is useful, but that of course attracts only the males and is of no use for direct control. Citronella also exercises a very specific attraction and we have already seen that half-a-dozen different species may occur in peaches.

The second means of control, the employment of natural parasites, has been tried in other countries but not yet in India. I spoke of this point before and need now only say once again that we are badly in need of information regarding these parasites and you can all help in this by sending us in specimens of those you rear or of affected fruits for us to rear out the flies and parasites here.

The third method of control, the destruction of the larvæ in the attacked fruit, is an obvious remedy as regards the succeeding crop, but it must be properly carried out to be effective. It is not of the slightest use to simply throw the affected fruit down on the ground or to bury it under a shallow depth of soil. Experiments have shown that a proportion of flies will emerge from puparia situated as much as five feet below ground. The affected fruit must therefore be buried *deeply* or rotted in water where the larvæ cannot escape or, better still, collected and boiled. This must be done before the larvæ have escaped and regular collection and destruction of fruit is therefore required in orchards and fruit-gardens.

Mr. T. V. Ramakrishna Ayyar. As regards control by destruction of attacked fruit, there was a very bad attack of Melon Fruitfly (*Dacus brevistylus*) at Coimbatore a couple of years ago. The early attacked fruits were picked and destroyed and the result of this treatment was promising.

Boring insects in peach trees include

Arbela tetraonis

which has been noticed boring peach-trees at Pusa, but it does not seem to be a regular pest of peach.

The sucking insects found on peach include :—

Monophlebus stebbingi octocaudata.

Lachnus sp.

Hyalopterus sp.

Monophlebus stebbingi octocaudatus occurs on peach as on so many other trees. We have already dealt with this under mango. At Pusa this scale sometimes occurs on the trees in regular masses.

Lachnus sp. is a large brownish Aphid common on peach-trees at Peshawar. It occurs in masses usually on the underside of branches, not on the leaves. The colonies can be dealt with fairly easily.

Hyalopterus sp. is the bright green Aphid occurring on peach leaves. It is common in Kumaon and at Peshawar and is controlled by spraying, as Mr. Robertson-Brown will tell us.

Spraying on a large scale is done in the orchard on the Agricultural Station at Taru, near Peshawar. Peach is a very sensitive tree and is easily affected by even a weak solution of any oily spray. After comparative trials, Katakilla has been found very useful against Green Aphis and is applied by means of Holder Sprayers. The total cost of application per acre comes to Rs. 12, the number of trees ranging from eighty to one hundred. The strength used is in accordance with the directions given on the packet. In my opinion it is always better to use proprietary insecticides ; it is no good making up a solution or emulsion on the spot. Katakilla has been found very efficacious in killing all the three species of Aphids which give us trouble and my opinion is that the Aphis problem can easily be solved by thorough spraying with Katakilla.

Any more pests of peach ?

In the Central Provinces, at Pachmarhi, there is a butterfly which pierces and sucks the sound fruits.

Kallima inachus has been reported to do that at Pachmarhi but the record seemed so doubtful that I omitted it from our list. Possibly the fruits are first pierced by a Noctuid moth such as *Ophideres*. We should like a further definite observation of damage done by *Kallima* and, if you can substantiate that, you can send us a short note on it for publication in the next Bulletin of Entomological Notes.

Plum (*Prunus cerasifera*).

We have few pests recorded on plum, probably because it is little grown in the Plains.

The leaves are attacked by various leaf-eating insects, mostly beetles :—

Brahmina coriacea.
Anomala lineatipennis.
Adoretus versutus.
„ *horticola.*
Euproctis flava.

The four beetles were all found at Jeolikote, devouring plum leaves [see Entomological Notes 11, 20 and 22 in Bulletin 59] and *Euproctis flava* is recorded from Lyallpur.

The fruits seem rather free from pests, but a larva of *Virachola isocrates* was once found feeding in a plum-fruit at Pusa.

Sucking insects on plum include *Monophlebus stebbingi octocaudata,* which is common throughout Northern India and which we have already considered several times, and a *Lecanium* sp. reported from Kashmir. When I was at Abbottabad in May 1916 I saw a large plum-tree very badly attacked by a brown scale-insect, which was clustered in masses over the twigs and branches; but it has not been identified as yet.

APRICOT (*Armeniaca vulgaris*).

The leaves of apricot have been found to be attacked in Kulu by *Emperorrhinus defoliator* [see under Peach] and the shoots were attacked at Jeolikote by *Anomala polita.*

The fruits are attacked by an unnamed Eurytomine Chalcidid in the Hazara District of the North-West Frontier Province. This is quite an interesting case because it is of course unusual to find phytophagous Chalcidids at all. The eggs are laid in the young fruits which wither and drop off the tree when about half-grown, so that attacked fruits do not come to maturity at all. The grub feeds inside the stone, eating out the seed, and remains inside the stone on the ground throughout the winter, emerging next spring: but in some cases, under Insectary conditions at Pusa, the grub may remain in a resting condition, two or perhaps more years. The damage done may be considerable but it is very local, only known at present in the Hazara District. Control should be attained simply by collection and destruction by fire of all stones of fallen fruit.

Mr. Robertson-Brown.

The attack is confined to a few gardens in Hazara situated at an altitude of 1,500-2,000 feet. This pest is not found in the common Hill varieties of apricot but all the grafted varieties are affected. The attacked fruits drop from the branches when they are three-quarters grown.

At Almora (7,000 feet), near Raniket, I found a Pentatomid bug thrusting its proboscis into ripe apricot fruit.

Apricots are also attacked by a *Lachnus* which occurs throughout the North-West Frontier Province and as far down as Saharanpur, and also in Baluchistan.

This Black Aphis is very common on the trunks of apricot trees in the North-West Frontier Province. It is checked by spraying with Katakilla.

ALMOND (*Amygdalus communis*).

We have a very meagre list of insect pests of almond. When I was at Haripur Hazara, in the North-West Frontier Province, in May 1915 I saw some almond trees which were said to be attacked by an insect which was apparently the same as the Eurytomine Chalcidid found in apricot; the symptoms were the same, the fruit falling from the trees before it became full-grown; I collected a quantity of the fallen fruit but we have not yet bred anything out of it, so whether almonds are attacked by a Chalcidid in this way is still an open question.

The Green and Black Aphids (*Hyalopterus* and *Lachnus*) found on peach in Peshawar are also common on almond. They also are said to occur in Baluchistan.

COUNTRY ALMOND (*Terminalia catappa*).

The leaves are attacked by a few insects:—

Apoderus tranquebaricus.
Selepa celtis.
Trabala vishnu.
Saissetia (*Lecanium*) *hemisphærica.*

Apoderus tranquebaricus is described and figured in "South Indian Insects," pp. 335-336, fig. 193, and there is little to add to this account. It has been noticed chiefly at Saidapet and in South Arcot, twisting the leaves, but is scarcely a pest.

Selepa (*Plotheia*) *celtis* has been recorded on *Terminalia* and may occur at times as a sporadic pest.

Trabala vishnu has been recorded on *Terminalia catappa* at Mandalay.

It was reared once on the leaves, but did not occur in any numbers.

Terminalia catappa is a new record for this, I think.

Saissetia (*Lecanium*) *hemisphærica* also occurs on *Terminalia* and may be a pest at times.

It was very bad on this tree at Kollegal.

JAMUN (*Eugenia jambolana*).

We have very few insects on our list under *Jamun*. A weevil, *Balaninus c-album*, has been bred at Pusa commonly from the fallen fruits, the grub feeding inside the seeds and eating the whole seed-content; but I do not know whether it can be considered a pest. **Mr. Fletcher.**

Dialeurodes eugeniæ has been found on *Eugenia jambolana* at Pusa, Poona, Coimbatore and Bangalore and is probably widely distributed in India, but I have not seen it in any numbers so as to be doing damage.

PEAR (*Pyrus communis*).

We have comparatively few insects listed under pear and doubtless a little search in the Hill Districts would add considerably to the list:— **Mr. Fletcher.**

Brahmina coriacea.
Adoretus versutus.
,, *horticola.*
Mimastra cyanea.
Emperorrhinus defoliator.

Brahmina coriacea, *Adoretus versutus* and *A. horticola* have all been reported from Jeolikote [see Entomological Notes 11, 20 and 22 in Bulletin No. 59].

Mimastra cyanea [see Stebbing, *Forest Coleoptera*, pp. 263-264] was sent in to us in May 1916 as defoliating pear-trees at Solan. It seems to be a common species in the Hill Districts of North-West India during the month of May and is found on almost all kinds of fruits.

Emperorrhinus defoliator was found attacking pear trees at Chawai, in Kulu, the whole orchard being defoliated. It occurs also in the Darjiling District and the Khasi Hills and is likely to do damage to fruit trees all along the Himalayan tract.

Sucking insects found on pear include:—

Tessarotoma quadrata.
Lachnus pyri.
Aspidiotus sp.

Tessarotoma quadrata was reported once on pear at Kalimpong but otherwise we do not know it as a pest.

Lachnus pyri is referred to in "South Indian Insects," p. 503, fig. 391, and is common on pear-trees in the Hill Districts of Southern India occurring in masses on the stems and branches in the same way as the *Lachnus* on peach. It is easily dealt with by spraying or brushing with any contact insecticide.

An *Aspidiotus* has been noted on shoots and stems of pear at Bangalore and is perhaps an imported species.

APPLE (*Pyrus malus*).

Apple leaves are attacked by numerous leaf-eating pests :—

Brahmina coriacea.
Adoretus versutus.
,, *horticola.*
Emperorrhinus defoliator.
Myllocerus 11-pustulatus.
Dereodus pollinosus.
Gracilariad.

Brahmina coriacea, *Adoretus versutus* and *A. horticola* have been reported from Jeolikote [see Entomological Notes 11, 20 and 22 in Bulletin 59]. *A. versutus* was also noted to damage apple seedlings at Jeolikote in May 1915. Probably various other Rutelid and Melolonthid beetles occur on apple leaves in the Hills.

Emperorrhinus defoliator was found eating apple leaves in Kulu in an orchard containing peach, apricot, pear and apple, but the apple trees were the last to be attacked.

Myllocerus 11-pustulatus was found at Bangalore on apple leaves and shoots.

Dereodus pollinosus [Marshall, *Fauna of India, Curculionidae*, Vol. I, p. 121] was found on apple at Kulu, and also occurs on *Zizyphus jujuba* and *Calotropis*. An unidentified brown weevil occurred commonly on leaves and shoots of apple at Abbottabad in May 1916 and seemed to be doing some damage.

In the North-West Frontier Province a Gracilariad caterpillar attacks apple leaves in May and has been noticed at Peshawar and Abbottabad, but the moth has not been bred out. The caterpillar is a miner in its early stages but later on ties up the leaves, fastening the edges together and living inside, gnawing the upper surface of the leaf. It pupates in a silken cocoon attached to the leaf. A good proportion of leaves may be affected.

Apple twigs have been noted to be gnawed at Bangalore by *Calosterna spinator* [" South Indian Insects," p. 325, fig. 180] but it is a minor pest as a rule, sporadically abundant.

Boring in apple stems and branches we have *Lophosternus hugeli* [Stebbing, *Indian Forest Coleoptera*, p. 274, tab. 17] which has been found boring in the trunks and roots in Kumaon. Stebbing reports it as boring in *Quercus incana* in North-West India.

At Taung-gyi, in the Southern Shan States, a yellow grub was found boring in apple. It is probably *Aristobia approximator.*

Apple fruits are apparently little subject to attack in India. *Tessaratoma quadrata* has been reported from Kalimpong and a larva of *Virachola isocrates* was once found at Bangalore boring into an apple. **Mr. Fletcher.**

So far as we know, the apple-growing districts in India are as yet free from the notorious Codling Moth (*Laspeyresia pomonella*) about which one sees so much in the literature of Economic Entomology in Europe, America, South Africa and Australia. I have never seen any signs of attack in any Indian-grown apple nor have I ever been able to hear of any such attack. But I would remind you that *Laspeyresia pomonella* has been recorded to occur in Kashmir, at a place called Dras Ladak (7,000 feet) [*Ann. Mag. Nat. Hist.* (7) VI, 435 (1900)] and, if it is really native in Kashmir, it is curious that it has never been noticed or spread in other localities. Possibly the Kashmir record was founded on a mistaken identification but, on the other hand, *L. pomonella* may occur in India. If any of you have an opportunity of obtaining evidence of its occurrence we should very much like to know about that.

Sucking insects found on apple include the notorious "Woolly Aphis," *Eriosoma* (*Schizoneura*) *lanigera*, which has been introduced into India on various occasions with nursery stock and which is thoroughly established in the Nilgiris and at Bangalore [" South Indian Insects," pp. 500-501, fig. 389], and has proved a serious pest. It is also common at Simla.

The Woolly Aphis is found on the roots and trunks of apple trees at Taung-gyi in the Southern Shan States. **Mr. Shroff.**

It seems to have been brought into all apple-growing districts with imported nursery stock and is an excellent example of the danger of introducing stock without any system of inspection or fumigation. **Mr. Fletcher.**

Control is dealt with in "South Indian Insects" and there is little to add to that. But control of this pest is decidedly difficult when it is living on the roots of the trees attacked.

SAPOTA : SAPODILLA (*Achras sapota*).

The leaves of Sapota seem to be little attacked by insects as a rule. The caterpillars of *Metanastria hyrtaca* [" South Indian Insects," pp. 409-410, fig. 282] were found on the leaves at Pusa in June 1916, but this insect is quite a sporadic pest.

The larva of *Rhodoneura myrsusalis* also webs up the leaves, but is not a pest; and the leaves are also nibbled by *Myllocerus 11-pustulatus*.

The fruits of Sapota are occasionally attacked by Fruitflies, of which *Chætodacus ferrugineus versicolor* and *C. zonatus* have been reared at Pusa, but Sapota fruits are rarely attacked by Fruitflies.

At Coimbatore a Mealy-bug occurs on the fruits.

Monophlebus stebbingi octocaudata also occurs on Sapota, as on so many other trees, but there is nothing particular to say about it and it seems to be less of a pest on Sapota than on other trees.

LOQUAT (*Eriobotrya japonica*).

The leaves of loquat seem fairly free from any serious leaf-eating pests. *Myllocerus discolor* has been noticed nibbling the leaves at Pusa and a *Megachile* also cuts the leaves. At Maymyo, in Upper Burma, a species of *Galerucella* was also found.

The fruits are attacked by a Fruitfly, *Chætodacus ferrugineus*, of which the forms *ferrugineus* and *dorsalis* have been bred at Pusa, but it is not very common. *Virachola isocrates* also occasionally attacks the fruits.

The sucking insects found on loquat include :—

Pulvinaria psidii.
Coccus (Lecanium) viridis.
Saissetia (Lecanium) hemisphærica.

Pulvinaria psidii is usually common on the young shoots and leaves, and *Coccus viridis* and *Saissetia hemisphærica* sometimes occur. We have already dealt with control of all these species.

NECTARINE.

We know practically nothing of any insect pests of Nectarine in India. *Calpe ophideroides* was found in Kumaon in July 1914 as recorded in Entomological Note 64 in Bulletin 59 ; and a species of *Lecanium* has been observed in Kashmir.

CHERRY (*Prunus* sp.).

Cherry pests are also a very unknown quantity in India. *Emperorrhinus defoliator* was found defoliating cherry trees in Kulu ; *Anomala transversa* has been recorded as a minor pest at Shillong [Entomological Note 13 in Bulletin 59] ; and *Myllocerus lefroyi* is recorded as defoliating cherry trees at Dehra Dun [Marshall, *Fauna of India*, *Curculionidæ*, Vol. I, p. 341].

FIG (*Ficus carica*).

The leaves of fig are eaten by numerous insects, including :—

Adoretus versutus.
,, *duvauceli.*
,, *horticola.*
Ocinara varians.
Phycodes radiata.
,, *minor.*

Adoretus versutus, *A. duvauceli* and *A. horticola* were all found on fig at Jeolikote [see Entomological Notes 20, 21 and 22 in Bulletin 59].

Ocinara varians is common on fig in the Plains and is often a serious pest, eating off the young growth as fast as it is put forth. It is described and figured in "South Indian Insects," p. 407, fig. 278. In the case of young trees, the larvæ may be hand-picked, but are difficult to see. It feeds, of course, on wild species of *Ficus* also, as all these fig-pests do.

Mr. Ramachandra Rao. *Perina nuda* was found on fig in the Botanical Garden at Coimbatore.

Mr. Fletcher. *Phycodes radiata* ["South Indian Insects," pp. 463-464, fig. 339] and *P. minor* are minor pests, especially of young trees, the caterpillars rolling and spinning up the leaves.

Boring insects in fig include :—

Batocera rubus.
Rhytidodera sp.
Olenecamptus bilobus.

Batocera rubus is sometimes a serious pest in young trees, the grub boring in the stem and killing the tree. In the case of young trees, the damage is usually done when noticed but in some cases it is possible to inject a mixture of creosote and chloroform, or carbon bisulphide, to kill the grubs ; but generally it is better to cut it out in the case of small trees. These should be examined daily when the beetles are about and the beetles collected off them by hand.

Mr. Robertson-Brown. *Batocera rubus* is very bad at Peshawar on fig-trees.

Mr. Fletcher. An unidentified Longicorn beetle, probably a species of *Rhytidodera*, has been reported on cultivated fig-trees at Mandalay.

Olenecamptus bilobus has also been reported on fig from Surat, Coimbatore and the Krishna Districts. It is common on wild figs but is not a bad pest of cultivated figs.

Fig fruits are attacked in the Peshawar Valley by the larva of *Stathmopoda sycastis*. I got a single specimen in 1916 and reared it out, and it proves to be a new species. It does not do very much actual damage but is well known to the local people who are chary of eating the fruits because they contain this caterpillar.

Mr. T. V. Ramakrishna Ayyar. At Coimbatore a Mealy-bug occurs on the fruit-stalks.

Mr. Fletcher. The sucking insects found on fig include *Ceroplastes floridensis* and Mites found on the leaves. It is possible that the peculiar scorched appearance of fig-leaves, as seen in the North-West Frontier Province, may be due to attacks of mites ; but this is a point which requires to be worked out.

JAK (*Artocarpus integrifolia*).

The buds and young shoots of jak are attacked by *Margaronia* (*Glyphodes*) *cæsalis*, as described in "South Indian Insects," p. 435, fig. 311, and I have no more to add to that.

Arbela tetraonis has been noticed boring in the stem at Pusa, but is not common on jak and not a regular pest.

The sucking insects found on jak include :—

Cosmoscarta relata.
Ptyelus sp.
Monophlebus stebbingi octocaudatus.
Pseudococcus (*Dactylopius*) sp.
Cerococcus corymbosus.

Cosmoscarta relata seems to be confined to Coorg and Mysore, where it is a serious local pest. It is described and figured in "South Indian Insects," p. 495, fig. 383.

In Malabar another Cercopid bug, *Ptyelus* sp., is found on jak shoots.

Monophlebus stebbingi octocaudatus is abundant on jak at Pusa, often clustering thickly on the young shoots and fruits.

In Malabar a species of *Pseudococcus* (*Dactylopius*) is very bad on the shoots and tender fruits, and *Cerococcus corymbosus* also occurs in Malabar, completely covering the shoots and young leaves and fruits.

The fruits of jak seem fairly free from pests, other than those we have already noticed, but at Pollibetta, in South Coorg, in May 1914 I bred *Chætodacus ferrugineus incisus* in some numbers from larvæ in ripe jak fruits and the rotten fruits lying on the ground also attracted *Ptecticus rufus* and *Pt. australis* in some numbers; but all these flies probably breed only in over-ripe and fallen fruits and thus are not pests.

BREAD-FRUIT (*Artocarpus incisa*).

Bread-fruit is grown to some extent on the West Coast of Southern India, but we know nothing of any insect pests.

I have never seen any insect pests on Bread-fruit.

DURIAN (*Durio zibethinus*).

Durian is grown in the South of Burma and at Moulmein is attacked by a borer, probably a Longicorn beetle, whose grub bores just below the bark. We do not know exactly what the beetle is but the grub can be controlled by cutting it out.

MANGOSTEEN (*Garcinia mangostana*).

Mr. Fletcher. We have no insect pests of Mangosteen on our list, although it is grown to some extent in Southern India, Ceylon and Burma. *Chætodacus garciniæ* was bred at Peradeniya from *Garcinia* fruits but I do not know whether these were mangosteens.

Mr. Shroff. At Moulmein a Bostrychid beetle bores in the stem and big branches of living trees of mangosteen.

BER (*Zizyphus jujuba*).

Mr. Fletcher. *Ber* is not strictly speaking a cultivated tree as a rule but in some districts the fruits of grafted varieties are utilized, so we may consider it under the heading of fruit trees.

There is a long list of leaf feeding insects and this could be further enlarged, but most of these are unimportant as pests :—

Thiacidas postica
Tarucus theophrastus.
Platypria andrewesi.
Atmetonychus peregrinus.
Xanthotrachelus faunus.
Myllocerus 11-pustulatus.
,, *transmarinus.*
,, *discolor.*
,, *sabulosus.*
Tanymecus circumdatus.
,, *hispidus.*

Thiacidas postica [" Indian Insect Life," p. 459, fig. 313] occurs throughout India and Burma and the larva is common on *Zizyphus*, but scarcely a pest.

Tarucus theophrastus [Bingham, *Fauna of India, Butterflies*, II, 417-419, t. 20, f. 151] occurs practically throughout India, Burma and Ceylon. The larva feeds on the young leaves and buds of *Zizyphus jujuba*. It is scarcely a pest as a rule but is stated to be a minor pest of grafted *Zizyphus* trees in the Central Provinces.

Platypria andrewesi [" Indian Insect Life," p. 364, figs. 241, 242] is common on *Zizyphus* in the Plains, the larva mining in the leaf in some numbers. There is also another Chrysomelid, a Cassidine, with a green larva which is common and eats patches out of the leaf-surface, sometimes to a considerable extent.

Atmetonychus peregrinus has been found on *ber* at Pusa on two occasions but is not a pest.

Xanthotrachelus faunus is common on *ber* at Pusa and does a little damage at times.

Myllocerus 11-pustulatus occurs on *ber* as on most other plants; *M. sabulosus* is common and a minor pest; *M. transmarinus* has been found at Pusa; and *M. discolor* was noticed at Jamalpur, in Bengal.

Tanymecus circumdatus and *T. hispidus* have occurred at Pusa, but the latter is probably only a casual visitor and neither is a pest.

The fruits of *ber* are attacked by :—

Carpomyia vesuviana.
Meridarchis scyrodes.

Carpomyia vesuviana is a small Fruitfly which derives its specific name from the fact that it was first discovered on the slopes of Mount Vesuvius, in Italy. It seems to occur commonly throughout India and is a minor pest of cultivated *ber* fruits. It is parasitized more extensively than any other Fruitflies we know in India and, as I told you the other day, we have been attempting to introduce the parasites into Italy. These parasites have been worked out by Professor Silvestri, who has named two species as *Biosteres carpomyiæ* and *Bracon fletcheri* from specimens sent from Pusa.

Meridarchis scyrodes has also been reared from larvæ in *ber* fruits at Pusa, Coimbatore and Nagpur, but it is probably scarcely a pest.

Boring insects in *ber* include :—

Arbela tetraonis.
Cœlosterna spinator.

Arbela tetraonis sometimes bores in *ber* but is not common in this tree as a rule.

Cœlosterna spinator was reported from Poona but is not generally a pest.

The stems of *ber* trees are attacked by a red mite which forms pustules on the bark, but we do not know what the mite is or much about it.

The only important sucking insect found on *ber* is the lac insect (*Tachardia lacca*) and, as that is usually cultivated, we can hardly describe it as a pest.

BERBERRY (*Berberis* sp.).

Anomala rufiventris, Anomala sp., *Brahmina cribricollis* and *Holotrichia fisa* have been found on berberry in Kangra, but we know no more about them.

WATER-NUT (*Trapa bispinosa*).
[*Singhara*—Hind.]

The only pest we know on water-nut is *Galerucella singhara*, which is fully described in Entomological Memoirs, Vol. II, pp. 146-149, tab. 15, so that we need not say much more about it.

At Raipur, in the Central Provinces, a caterpillar was found boring in the nuts but the moths could not be bred out.

CASHEW (*Anacardium occidentale*).

The leaves of cashew are sometimes seriously defoliated by caterpillars of *Cricula trifenestrata*, which we considered under mango. **Mr. Fletcher.**

In Bangalore and South Kanara the shoots are attacked by *Helopeltis antonii*, and the leaves are also attacked by *Ceroplastes floridensis* at Bangalore. **Mr. T. V. Ramakrishna Ayyar.**

MULBERRY (*Morus* spp.).

Mulberry is not usually grown as a fruit tree in India but it is frequently planted as a shade-tree and is of course used extensively also for rearing silkworms. **Mr. Fletcher.**

Mulberry leaves do not seem to be much eaten by insects and at Pusa, where we grow mulberry extensively as food for silkworms, we have never had any trouble due to attacks of caterpillars or other leaf-eaters. Weevils may nibble the leaves at times and *Sympiezomias cretaceus* has been found doing this at Bangalore.

Boring beetles often do considerable damage and amongst these we may consider :—

Apriona germari.
,, *cinerea.*
Sthenias grisator.

Apriona germari does considerable damage to mulberry in North-Western India and is described and figured by Stebbing in his "Indian Forest Coleoptera." pp. 371-374, fig. 249.

At Abbottabad a longicorn larva was found boring mulberry trees seriously in May 1916, the larval gallery generally running up and down the tree just below the bark and the boring being plainly visible by the accumulation of extruded fragments of wood. A larva was brought back to Pusa but could not be reared ; possibly it may have been *Apriona germari.*

Apriona cinerea is recorded by Stebbing [*l. c.*, p. 374] as damaging mulberry at Dehra Dun by the beetles stripping the bark off the leading shoots and twigs.

In the Central Provinces a longicorn beetle eats the bark of mulberry trees, but I cannot say what the beetle is. **Mr. Ratiram.**

Sthenias grisator was found ringing mulberry at Coimbatore and a good deal of damage was done by the beetles cutting off branches. We discussed this beetle under *Erythrina.* **Mr. Fletcher.**

Sthenias grisator is quite a common pest of mulberry in that way at Coimbatore. **Mr. T. V. Ramakrishna Ayyar.**

I have also found adult beetles of *Glenea multiguttata* resting on mulberry at Bangalore as if they were attracted to this plant, but I cannot **Mr. Fletcher.**

say definitely that they had bred in mulberry. Stebbing [*Indian Forest Coleoptera*, p. 378] gives *Odina wodier* as the food-plant of this insect.

The sucking insects found on mulberry include :—

Monophlebus stebbingi octocaudatus.
Pseudococcus (*Dactylopius*) sp.
Saissetia (*Lecanium*) *nigra.*
Mites.

Monophlebus stebbingi octocaudatus is a minor pest of mulberry, especially when grown as trees. I do not think there is much more to say about this species.

Pseudococcus sp. occurs on mulberry commonly and is supposed to produce the curly appearance of the shoots commonly called "*tukra*," but this is a point which requires more exact investigation. Lefroy has stated in the *Agricultural Journal of India*, Vol. V, pp. 162-164, that the mealy-bug concerned is *Pseudococcus* (*Dactylopius*) *nipæ*, but this also is doubtful and it is probable that *Ps. citri* is the species most commonly present. We want to know whether the "*tukra*" condition is solely due to the attacks of these mealy-bugs and, if so, whether only one or more, and which, species are concerned. In the case of an outbreak of "*tukra*," the only control is the prompt plucking and burning of the affected shoots.

Saissetia (*Lecanium*) *nigra* occurs fairly commonly on mulberry, but is not a bad pest.

Mites occur sporadically as pests, and seem to occur mostly in dry areas. We do not know the species concerned—indeed, nothing has been done with phytophagous mites in India so far. As regards control, a sulphur spray is indicated when required but as a rule the value of this crop does not justify remedial measures.

STRAWBERRY (*Fragaria vesca*).

Strawberry is grown chiefly in Northern India, both in the Hills and Plains. In the Peshawar Valley, for example, strawberries are grown as a field-crop. There seem, however, to be few insect pests of this crop. At Pusa *Myllocerus 11-pustulatus* and *M. blandus* have been noticed nibbling the leaves and at Shillong Scarabæid grubs have been reported as damaging the roots.

CUSTARD APPLE (*Anona squamosa*).

We have no leaf-eating insects noted as found on Custard Apple. The fruits are attacked by :—

Heterographis bengalella.
Pseudococcus (*Dactylopius*) *virgatus ?*

The larva of *Heterographis bengalella* bores in the ripe fruits in Bengal and Bihar, but is not common and can hardly be described as a pest.

A species of *Pseudococcus*, probably *virgatus*, sometimes clusters in masses on the fruits and spoils their appearance for market, besides doing damage by sucking the juices.

Ceroplastes floridensis has also been noted on the leaves, but is scarcely a pest.

CHERRAMOYA (*Anona* sp.).

The Cherramoya is a large species or variety of Custard Apple and is cultivated in the Hills of South India and Burma. The only insect pest which we know of is *Aristobia approximator* which has been found boring the stems and branches at Taung-gyi in the Southern Shan States, Burma.

TAMARIND (*Tamarindus indica*).

There are no very important pests of the tamarind tree. The larva of *Stauropus alternus* has been found eating the leaves, but not as a pest; however, it is possible that it may occur sporadically in large numbers as it did on tea in Ceylon some years ago.

The fruits are attacked by *Virachola isocrates*, which occasionally occurs, and by *Argyroploce illepida* which bores in the seeds; but neither is much of a pest. *Caryoborus gonagra* [" South Indian Insects," pp. 308-309, fig. 157] is a bad pest of the seeds but this affects only the stored fruit. *Aspidiotus lataniæ* has been found on the pods at Bangalore.

Aspidiotus tamarindi and *A. orientalis* cover the fruits at Coimbatore. **Mr. Ramakrishna Ayyar.**

At Mandalay the stem is attacked by longicorn borers. **Mr. Shroff.**

PAPAYA (*Papaya carica*).

Papaya affords an example of almost perfect immunity from insect attack and young healthy trees never seem to be attacked by insects of any kind. Older, but still living and vigorous, trees are occasionally attacked by the caterpillar of *Dasyses rugosellus* which bores in below the bark. The direct damage done is slight and the larval workings are easily seen and can be cut out and the wound tarred over. **Mr. Fletcher.**

The next group of plants is comprised of

PALMS

and of these we will first take

COCONUT (*Cocos nucifera*).

Coconut is grown extensively in India, especially along the West Coast of Southern India, in Burma and Ceylon and is attacked by numerous insect pests of which some do serious damage.

The young plants are attacked by :—

Termites.

Dorylus orientalis.

Termites are sometimes serious pests of young coco-palms, especially in Malabar. The use of a deterrent is indicated, to keep them away, and trials might be made with Apterite or some such insecticide in a ring around the young plants. Possibly waste tobacco stems, if available locally, might also prove useful.

Dorylus orientalis [" South Indian Insects," p. 274, fig. 111] attacks young plants in the same way as termites do and control will be on similar lines.

The leaves and shoots of coconut are attacked by :—

Gangara thyrsis.

Suastus gremius.

Parasa lepida.

Contheyla rotunda.

Nephantis serinopa.

Oryctes rhinoceros.

Aularches miliaris.

Stephanitis sp.

Aspidiotus destructor.

Vinsonia stellifera.

Pseudaonidia trilobitiformis.

Coconut Aphid.

Gangara thyrsis [" South Indian Insects," p. 417, figs. 290-291] is a common species throughout the Plains of India, Burma and Ceylon. The larva feeds on palms of various kinds and may do some damage to ornamental plants and in nurseries of young coco-palms. The caterpillar rolls the leaves and lives inside the rolled tube, its presence being easily determined by the fluffy white waxy matter which surrounds the caterpillar and is also scattered over the leaves. It may be hunted down and killed by hand in the case of small palms which are the only ones badly affected. Pupation takes place in the larval tube.

In Burma, *Gangara thyrsis* is a bad sporadic pest on young coco-palms.

Suastus gremius [" South Indian Insects," pp. 418-419, fig. 293] is widely distributed in the Plains, the larva feeding on various palms; mostly on palmyra, but also on coconut and date. It is a minor pest as a rule, sometimes occurring in considerable numbers. In the case of small palms, the larvæ may be killed by hand.

Parasa lepida [*l. c.*, pp. 410-411, figs. 283-284] is an occasional serious pest of coconut, especially in Southern India, even large palms being

stripped of leaves. In such cases, if the larvæ are present in sufficient numbers, the attacked branches may be cut and burnt; and the cocoons on the tree-trunks may also be squashed. Spraying is impracticable in the case of large palms but can be done, or the caterpillars picked off, in the case of small plants.

Contheyla rotunda, a hitherto scarce species originally described from Kanara, occurred as a pest of coconut in South Malabar in February and March 1916, the larvæ damaging the foliage and sometimes the flower-shoots and rinds of young nuts. When full-fed, the larva pupates in a small, oval, hard, shell-like cocoon, numbers of which are found on badly attacked tree-fronds. Spraying with Lead Arsenate was tried but found impracticable, and the preventive measures of cutting off first-attacked fronds and the destruction of the shell-like cocoons found on the trees before an outbreak were suggested and taken up by the ryots. This species has also recently been reported as a pest of tea in the Wynaad.

Nephantis serinopa [" South Indian Insects," p. 460, fig. 336] occurs throughout the Plains of Southern India, Bengal, Burma, and Ceylon as a pest, often serious, of coconut. It also occurs commonly on palmyra but does not damage this so much. In the case of large trees, the cutting and burning of the first-attacked branches is the only practicable method. A few moths are attracted to light-traps but it is doubtful how far these are really efficient. In the case of small trees, spraying with a stomach-poison is possible.

Nephantis serinopa is very common in Burma. **Mr. Shroff.**

In Bengal, *Nephantis serinopa* has been found bad on palms in Burdwan and the Presidency Divisions. **Mr. P. C. Sen.**

Oryctes rhinoceros [" South Indian Insects," p. 285, tab. 3] is common in all coconut-growing districts and is a bad pest, not only by boring into the soft crowns of the trees but by providing thereby a means of entry for *Rhynchophorus ferrugineus* to lay its eggs in the palms. The lifehistory has been worked out and described in Entomological Memoirs, Vol. II, pp. 193-204, and there is not much more to say about that; I called your attention to the fact that rotting *Agave* stumps often provide a suitable situation for the grubs to live in, and they have also been found in the rotting mass of pulp left over after pulping coffee-berries. As the early stages are passed in rotting vegetable matter, control may aim at destruction of the grubs as well as the adult beetles. Heaps of rotting vegetable matter near palm groves should be regularly turned over and the grubs picked out and destroyed and all dead and rotten palms should be cut and burnt. It may be noted that in the case of palms, which have died from bud-rot, the dead top-shoots may **Mr. Fletcher.**

provide a suitable breeding-place for the grubs; and in such circumstances it is also possible that the spores of the disease may be carried to healthy trees by beetles which have flown from diseased trees either after ovipositing there or on first emergence from the pupal state. In some places, such as Samoa, where *Oryctes* is a pest, small enclosures are built up of coral rock in the coconut plantations and these enclosures are filled with decaying coconut husks and similar material to act as traps for the grubs; this material may then be infected with a culture fatal to the grubs or may simply be turned out regularly and the grubs destroyed. But there is a danger that, if this destruction is not done regularly and systematically, such enclosures would simply form breeding-centres for the beetles. In districts where pigs are kept, these animals will also keep down the grubs if allowed to rout about in the piles of decaying vegetable matter. The beetles themselves may be extracted from their burrows in the trees by means of a barbed wire. In some districts a mixture of salt and sand is placed in the crowns of the trees and this is said to be effective, as is also the fermented liquor method as described in my book.

Aularches miliaris [" South Indian Insects," p. 526, fig. 418] occasionally occurs on coconut but is not a pest as a rule.

Stephanitis sp. occurs in small numbers on coconut leaves. I have seen it at Coimbatore but never in any numbers. The species has not been identified. It may be *S. typicus*.

I have once seen it at Coimbatore but it was not doing much damage.

Aspidiotus destructor [" South Indian Insects," p. 518, fig. 408] occurs throughout the Plains of Southern India and probably throughout our limits. It is often found in very large numbers, literally covering the leaves, when the vitality of the tree is obviously lowered.

At Coimbatore *Aspidiotus destructor* sometimes occurs on coconut in destructive numbers.

Control is difficult. It is not possible to cut and burn all the branches of a tree and, short of that, little can be done in the case of a really bad attack. Spraying is rather outside practical politics in the case of coconut palms.

Vinsonia stellifera is a very widely distributed Scale-insect, recorded from the West Indies, Central and South America, California and Ceylon, and found on orchids, ferns, guava, mango, nutmeg, etc. It is found at times on coconut, sometimes in numbers, but is hardly a serious pest as a rule.

Pseudaonidia trilobitiformis occurred in numbers on coconut at Colombo on one occasion. I do not know whether it has been found on coconut in India but it is likely to occur.

A Coconut Aphid was described in "South Indian Insects," pp. 506-507, fig. 393, from specimens found at Coimbatore on young coconut palms which had been imported from Colombo. That colony appears to have been exterminated by the measures taken at the time and I hope that we shall not have occasion to notice this insect in India again.

The stems of coconut are attacked by :—

Rhynchophorus ferrugineus.
Coconut Scolytid.

Rhynchophorus ferrugineus is described and figured in "South Indian Insects," p. 343, tab. 14, and the lifehistory is given in greater detail in Entomological Memoir, Vol. II, Part 10; so that we need not go into that in any detail. *Rh. ferrugineus* is probably the worst and most destructive pest of coconut and palmyra palms in India and its increase is rendered possible by the cuts made by toddy-drawers and the borings of *Oryctes* in the crowns of the trees; for, as I have pointed out before, *Oryctes* and *Rhynchophorus* are mutually interdependent and between them do a great deal of damage which either insect by itself would be unable to accomplish. The adult *Oryctes* bores into the crown of a palm but this is, in the still living tree, an unsuitable situation for its grubs which require rotting vegetable matter to live in. Along comes a *Rhynchophorus* and oviposits in the burrow made by the *Oryctes*; the living tissue surrounding this burrow is suitable food for the *Rhynchophorus* grubs, which burrow in it and feed on it and, when full-fed, pupate in it and emerge as adults. The tissues mined by the *Rhynchophorus* grubs rot, a process assisted by the lodgment of rain in the crown, and the crown, now dead, becomes a suitable place for the *Oryctes* beetle to oviposit in and for its grubs to develop in. So that the destruction of *Oryctes* and of dead trees in which *Oryctes* can breed will directly lead to the control of *Rhynchophorus* also. All wounds and cuts in the trees, which would give an entrance for *Rhynchophorus* to oviposit, should also be tarred over as far as possible or otherwise protected. At Mercara, in Coorg, in October 1915, I noticed that numerous specimens of *Rhynchophorus ferrugineus* were attracted to the trunk of a newly-felled palm-tree; possibly it might be possible to trap the adult beetles in this way, when palms are being cut for any other purpose.

An unidentified Scolytid beetle bores in the stems of coconut palms at Negapatam and in the Godavari District, killing the attacked trees. It is a minor local pest, but we know little about it.

PALMYRA (*Borassus flabelliformis*).

The pests of palmyra are practically identical with those of coconut, so that we need only run over the list very briefly. Attacking the leaves and shoots we get :—

Suastus gremius.
Parasa lepida.
Nephantis serinopa.
Oryctes rhinoceros.

and boring in the stem we find :—

Rhynchophorus ferrugineus.

All these attack palmyra in the same way as they do coconut and there is nothing special to say about them.

DATE PALM (*Phœnix sylvestris*).

The pests of the date palm are very similar to those on coconut and palmyra, but date is grown more in Northern India. On the leaves and shoots we find :—

Oryctes rhinoceros.
Oryctes nasicornis.
Wallacea sp.

Oryctes rhinoceros occurs on date in just the same way as on coconut.

Oryctes nasicornis probably occurs in date palms in North-West India. We have specimens from Quetta and had for determination from Mr. Milne one specimen captured by him at Dalhousie.

Wallacea sp. is a Hispine beetle which has been noted at Pusa as doing minor damage to top-leaves of date-palms.

The beetle and grubs were gnawing the epidermis of unopened tender leaves.

In the stems of date-palms we get *Rhynchophorus ferrugineus* boring in the same way as in coconut and control will be similar.

BETEL-NUT PALM (*Areca catechu*).

[*Supari*—Hind.]

The Betel-nut Palm differs from coconut, palmyra and date in being singularly free from insect attack—indeed, none of the palm-living insects that we have just discussed seem to have been found on betel-nut. The only pests noted on betel-nut palms are *Chrysomphalus* (*Aspidiotus*) *aonidum* (*ficus*) and *Hemichionaspis aspidistræ*, which occur not uncommonly, but are scarcely pests.

ORNAMENTAL PALMS.

Under the heading of Ornamental Palms we may consider the palms grown in gardens and kept in houses for ornamental purposes. As

a rule they are small palms and their pests are amenable to treatment by hand. Besides the palm pests we have already noted under coconut, palmyra, date and betel-nut, we often find the leaves attacked by Psychids, whose larval cases are easily hand-picked. Scales of various sorts may also occur at times and can be dealt with by spraying or rubbing.

Ornamental palms lead us on to a few miscellaneous

GARDEN PLANTS

of which the first is

AILANTHUS EXCELSA.

The leaves of *Ailanthus excelsa* are eaten by :—

Solenopsis geminata.
Eligma narcissus.
Atteva fabriciella.

Solenopsis geminata [" South Indian Insects," pp. 274-275, fig. 112] does considerable damage to tender *Ailanthus* leaves, especially of small plants, by gnawing the leaves—not " growing " the leaves, as misprinted in " South Indian Insects."

Eligma narcissus [*l. c.*, pp. 383-384, figs. 58, 247, 248] is common throughout Southern India and the caterpillars often strip the leaves of *Ailanthus*. The caterpillars are conspicuous and may be hand-picked, and the long, greyish cocoons, which are thickly clustered on the stem, may also be squashed.

Attera fabriciella [*l. c.*, pp. 461-463, fig. 338] also attacks *Ailanthus* in Southern and Central India, whilst the allied *A. niveigutta* is found on *Ailanthus* in Bengal and Sylhet. The caterpillars feed in a common web, which is conspicuous and easily torn down and the caterpillars destroyed.

CHRYSANTHEMUM.

The leaves of Chrysanthemum are at times attacked by larvæ of *Diacrisia obliqua* but this is rarely a bad pest. The larvæ may be hand-picked whilst young and still gregarious.

Aphids are common on Chrysanthemum, especially on the tender stalks. They are usually checked by Coccinellids and Chrysopids or may be sprayed with a soap solution.

The roots of Chrysanthemum also are sometimes attacked by termites and the application of a deterrent, such as Crude Oil Emulsion, will drive them away temporarily.

ROSE (*Rosa* spp.)

Roses are cultivated in most gardens throughout India and we have naturally a long list of insect pests. The leaves are eaten by :—

Adoretus versutus.
Adoretus lasiopygus.
Adoretus bicaudatus.
Adoretus caliginosus.
Adoretus stoliczkæ.
Chiloloba acuta.
Cryptocephalus dodecaspilus.
Megachile anthracina.
Megachile disjuncta.
Prodenia litura.
Selepa celtis.
Stauropus alternus.
Eucosma zelota.
Helcystogramma hibisci.

The various species of *Adoretus* are bad pests of rose, the leaves being often practically eaten away by these beetles, which usually appear in Northern India at the beginning of the Rains. *Adoretus bicaudatus* is recorded from Fenchuganj in Entomological Note 17 in Bulletin 59; *A. lasiopygus*, *A. caliginosus* and *A. versutus* in Entomological Notes 18-20; and *A. stoliczkæ* occurs at Nagpur.

Chiloloba acuta [" South Indian Insects", p. 284, fig. 124] was found on rose at Poona, but is not common on rose as a rule.

Cryptocephalus dodecaspilus occurs on rose as a very minor pest at Abbottabad in May.

Megachile anthracina and *M. disjuncta* are both common leaf-cutting bees, which cut out large circular patches of leaf and often disfigure garden plants quite considerably.

Prodenia litura [" South Indian Insects," p. 377, tab. 19] occasionally occurs on rose but is not common on this plant.

Selepa celtis sometimes occurs in some numbers but is sporadic in its appearance.

Stauropus alternus [*l. c.*, p. 408, figs. 279-280] occasionally occurs on rose, but is a scarce insect as a rule.

Stauropus alternus occurs on rose at Coimbatore.

Eucosma zelota occurs commonly on rose at Abbottabad, the larva spinning together a bunch of leaves so that the growth of the stem is distorted and the plant disfigured. It occurs on cultivated and wild varieties. The bunches of leaves are conspicuous and the only remedy

would be to cut them out and destroy the caterpillars. I found a very similar caterpillar at Shillong but could not breed it, so cannot say whether it was identical.

Helcystogramma hibisci was reared at Nagpur on rose but is not a pest.

Achæa janata was also recorded on rose-leaves at Nagpur. **Mr. Khare.**

Rose is a very unusual foodplant for *A. janata*. **Mr. Fletcher.**

The buds and flowers of rose are attacked by :—

Heliothis obsoleta.

Chiloloba acuta.

Various Cetoniads and Meloids.

In the North-West Frontier Province, in the Kohat Valley, I found rose-buds badly bored by caterpillars of *H. obsoleta* and the same damage occurs in other parts of the North-West Frontier Province. The whole of the inside of the flower is eaten out. The only remedy is to collect and destroy the attacked buds which are conspicuous by the hole of entry of the caterpillar.

Chiloloba acuta has also been noticed attacking rose flowers at Poona and various other Cetoniad and Meloid beetles also damage the flowers. They may be caught by hand or in hand-nets.

Boring insects attacking rose include :—

Sthenias grisator.

Cœlosterna spinator.

Ceratina hieroglyphica.

Sthenias grisator ["South Indian Insects," p. 326, fig. 182] girdles rose-stems in the same way as it attacks *Erythrina* and may do a good deal of damage. [See under *Erythrina*.]

Cœlosterna spinator [*l. c.*, p. 325, fig. 180] is not a regular borer in rose, but the adult beetles are sometimes found gnawing twigs.

Ceratina hieroglyphica is a small bee which is found boring into the pith of pruned branches of rose-trees at Pusa and Bangalore. It probably only bores in dead or dying stems and is therefore scarcely a pest.

At Nagpur there is another borer in rose-trees. It is like *Arbela* but I cannot say definitely what it is. **Mr. Khare.**

The roots and stems, and also cuttings, are sometimes attacked by termites. Watering with Crude Oil Emulsion or a weak solution of Phenyle will drive them away temporarily. **Mr. Fletcher**

Sucking insects found on rose include :—

Aspidiotus orientalis.

Chrysomphalus (Aspidiotus) aurantii.

Icerya ægyptiaca.

Aleyrodes cotesii.

Aspidiotus orientalis has been noted on rose-stems at Bilaspur, Poona and Ahmednagar.

Chrysomphalus (*Aspidiotus*) *aurantii* is found on stems of rose-bushes and has been noticed at Tezpur and Pusa. It is sometimes a serious pest, killing back the attacked stem. It is checked by spraying with a resin-soap mixture.

Icerya ægyptiaca has also occurred on rose at Pusa---probably a stray infection from crotons on which it is common.

Aleyrodes cotesii was described from examples found on rose in Baluchistan but does not seem to be known otherwise.

CYCADS (*Cycas circinalis* and *C. revoluta*).

Cycads are sometimes attacked rather badly by the larvæ of *Catochrysops pandava*, which occurs in most parts of the Plains of India, Burma and Ceylon. The plants attacked are disfigured for ornamental purposes. A spray of Lead Arsenate is usually efficient.

Chrysomphalus (*Aspidiotus*) *aurantii* has also been found on Cycads in Bombay and *Aspidiotus orientalis* has been reported on *Cycas revoluta* in Calcutta. We do not know how far these Scale-insects are pests.

LILIES.

Lilies of various sorts grown in gardens are often badly attacked, their leaves being eaten by :—

Polytela gloriosæ.
Brithys crini.
Chalcnosoma metallicum.

Polytela gloriosæ is described and figured in " South Indian Insects," pp. 375-376, fig. 238, and we have since issued a coloured plate showing the lifehistory. The blackish white-spotted caterpillar is often common on *Gloriosa superba*, *Amaryllis* and various garden lilies. As a rule the caterpillars hide away near the roots of the plants in the daytime but crawl up on the leaves in the evening and are best caught then or in the early morning, when they are easily collected by hand. *P. gloriosæ* is widely distributed throughout the Plains of India, Burma and Ceylon.

Brithys crini (*Glottula dominica*) occurs throughout India and Burma and is an occasional pest of ornamental lilies in gardens, its caterpillar being very similar to that of *P. gloriosæ* and having the same habits. We have specimens reared on garden lilies at Pusa, Shillong, Daltonganj and Mandalay. In Java also the larva has been reared on *Crinum* and *Crocus*.

Polytela gloriosæ, Fb.

The plate shows two fullgrown caterpillars on plants, a pupa in the pupal cell and a moth in flying attitude. All are about life-size.

POLYTELA GLORIOSÆ.

Chalænosoma metallicum is a small brilliant green Halticine beetle found as a pest on lilies in the gardens at Ootacamund. It may be collected by hand.

At Nagpur we get a leaf-miner, perhaps a species of *Agromyza*, in garden lilies. **Mr. Khare.**

OLEANDER (*Nerium odorum*).

The leaves of oleander are eaten by the caterpillars of :— **Mr. Fletcher.**

Pericallia ricini.
Deilephila nerii.
Euplæa core.

Pericallia ricini [" South Indian Insects," pp. 370-371, fig. 232] is not commonly found on oleander. but occasionally occurs and may do damage when in numbers. Picking of the young larvæ will provide control.

Deilephila nerii [*l. c.*, pp. 403-404. figs. 273, 274], as its specific name implies, feeds on oleander and is a frequent minor pest in gardens. Owing to the large size of the larvæ, considerable defoliation may be produced. They may be hand-picked but are not easy to see.

Euplæa core occurs fairly commonly on oleander but is scarcely a pest.

The stems of oleander have been reported as " ringed " by *Sthenias grisator* [see under *Erythrina*] in Palitana. but this is not a common form of injury.

The leaves and shoots are also sometimes very badly attacked by a small round Scale-insect. which chiefly affects potted plants. but it does not seem to have been identified.

Parlatoria pergandii is bad on the leaves. stems and shoots of oleander in Madras. **Mr. Ramakrishna Ayyar.**

TULSI (*Ocimum sanctum*).

Tulsi leaves are eaten by the larva of *Lyncestis amphix* and the leaves are rolled by the larva of *Syngamia abruptalis*. The larva of *Lyncestis amphix* is figured in " Indian Insect Life," p. 446. fig. 306. under the name of *Euscotia* sp. **Mr. Fletcher.**

Monanthia globulifera [" South Indian Insects," pp. 485-486. fig. 371] is also a minor pest. sometimes causing the leaves to turn yellow. and *Ceroplastodes cajani* [*l. c.*, p. 512. fig. 400] has also been recorded on *tulsi*.

DAHLIA.

Argyroploce aprobola is said to have been reared at Nagpur from a larva found on Dahlia flowers, but the record requires confirmation.

Dorylus lævigatus was found eating Dahlia stems at Alipur in February 1913, but otherwise we do not know it as a pest.

BALSAM (*Balsamifera impatiens*).

The leaves of Balsam are eaten by the caterpillar of *Theretra oldenlandiæ*, which is a pest of this plant in Bihar. One caterpillar may entirely strip a plant of its leaves.

The stems are also bored by the larva of *Metialma balsaminæ* which occurs regularly at Pusa and was also found at Poona in October 1916.

Metialma balsaminæ usually occurs late in the season. The bored stem swells out into a sort of gall. Pupation takes place in the stem in a special cocoon made of fibre.

The only control possible would seem to be the destruction of the attacked plants.

BOUGAINVILLEA.

Bougainvillea seems remarkably free from leaf-eating pests, but *Sthenias grisator* [see under *Erythrina*] has been noticed "ringing" the stems. It is not a pest of this plant as a rule.

VIOLET (*Viola odorata*).

There are few pests of violet. The leaves are occasionally eaten by the caterpillar of *Argynnis hyperbius* (*niphe*), but this is not a pest. A Cetoniad beetle, *Epicometis squalida*, was once sent in from Quetta as attacking violets, but otherwise we do not know it. *Pseudococcus* (*Dactylopius*) *virgatus* sometimes occurs in numbers and is a regular minor pest, sometimes serious. The plants attacked should be sprayed with Fishoil-resin soap solution or similar contact insecticide.

At Maymyo, larvæ like those of *Athalia proxima* were found on violets.

CROCUS.

Epicometis squalida was sent from Quetta on one occasion as attacking Crocus, presumably by eating the flowers. The beetles should be easily hand-picked.

The larvæ of *Polytela gloriosæ* and *Brithys crini* also eat the leaves. We took those under lilies.

HYACINTH.

Epicometis squalida was sent from Quetta on the occasion already noted, as attacking violet, Crocus, Hyacinth and Narcissus, presumably by eating the flowers, in which case the beetles could be collected by hand.

NARCISSUS.

[See above.]

NASTURTIUM (*Tropæolum* sp).

The only insect pest that seems to attack Nasturtium is the caterpillar of *Pieris brassicæ*, which is occasionally found on the leaves. Some larvæ bred on this diet at Pusa yielded an unusual aberration described in Entomological Note 68, fig. 15, in Bulletin 59. The larvæ of *P. brassicæ* are easily hand-picked whilst they are still young, before they have scattered.

The next group of plants whose pests we will take comprise those used as

DRUGS and DYES.

TOBACCO (*Nicotiana tabacum*).

Tobacco is grown practically throughout India and Burma and has a fairly long list of pests.

The young seedlings are attacked by :—

Agrotis ypsilon.
Flea Beetles.
Halticus minutus.
Chrotogonus spp.
Atractomorpha crenulata.
Brachytrypes portentosus (*achatinus*).
Gryllotalpa africana.

Agrotis ypsilon was discussed under Gram. It is common in most tobacco-growing districts and often does considerable damage by cutting the young plants. When these have been planted out, the cut plants are conspicuous and the caterpillar may be grubbed up with a bit of stick : it will usually be found hiding in the soil near the roots of the cut plant.

Mr. Shroff. In 1906 damage was done to tobacco plants by Agrotis at Bassein, in Burma.

Mr. Fletcher. Flea-beetles, of one or more unidentified species, also damage seedlings at times whilst still in the seed-beds before being planted out. When doing damage they may be caught in hand-nets.

Halticus minutus [" Indian Insect Life," p. 707, fig. 479], a small Capsid bug very like a Flea-beetle in appearance, also occurs in seed-beds and attacks the young plants. Collection by hand-nets is indicated.

Chrotogonus [" South Indian Insects," pp. 528-529, tab. 49], whether of one or more species I cannot say, is also sometimes a serious pest of

young tobacco plants. Control by bag-nets is usually most effective. In Madras the Texas bait treatment gave good results, but this was not found to be the case at Pusa.

Atractomorpha crenulata attacks young plants but we will take that later on.

Brachytrypes portentosus (*achatinus*) [*l. c.*, p. 536, fig. 430] is usually a minor pest of tobacco seedlings in Bihar and Bengal, but only very young crickets are about at the time that the tobacco plants are small, so that little damage is done as a rule.

At Bassein, in Burma, some damage was done to tobacco by *Brachytrypes* in 1906.

Gryllotalpa africana [*l. c.*, pp. 534-535, fig. 428] sometimes does a little damage to young plants but this is probably incidental to its burrowing in the ground rather than due to deliberate attack.

At Dacca a small amount of damage is done to seedlings by the burrowing of *Gryllotalpa*.

The leaves of tobacco are eaten by :—

Diacrisia obliqua.
Heliothis assulta.
Prodenia litura.
Plusia signata.
Plusia nigrisigna.
Atractomorpha crenulata.

Diacrisia obliqua is an occasional pest of tobacco, chiefly in Bihar and Bengal. The young larvæ may be hand-picked before they have scattered, if eggs have been laid on the tobacco.

Heliothis assulta is described and figured in "South Indian Insects," p. 374, fig. 236, and we have just issued a coloured plate showing the lifehistory. This species is widely distributed in India (except in the extreme North) and Burma and is a minor, occasionally a major, pest of tobacco, the caterpillars eating holes in the leaves, as is clearly shown in the coloured plate. We have examples reared on tobacco at Pusa, Nadiad (Bombay), Anand, Madras, and Amarapura (Burma). It has also been reared at Pusa from larvæ on *tur* (*Cajanus indicus*) pods, *Physalis minima*, *Ph. peruviana* and on a wild species of *Physalis*, but it is not a pest except on tobacco. The eggs are laid singly on the leaves and the caterpillars feed usually on the top-leaves, biting holes in them. Pupation takes place in the soil. As regards control, the bitten leaves are conspicuous and the fact that the damage has been caused by *H. assulta* is evident by the accumulation of frass on the leaves, the black pellets of excrement being quite conspicuous. The caterpillars may then be searched for and hand-picked.

Heliothis assulta, Gn.

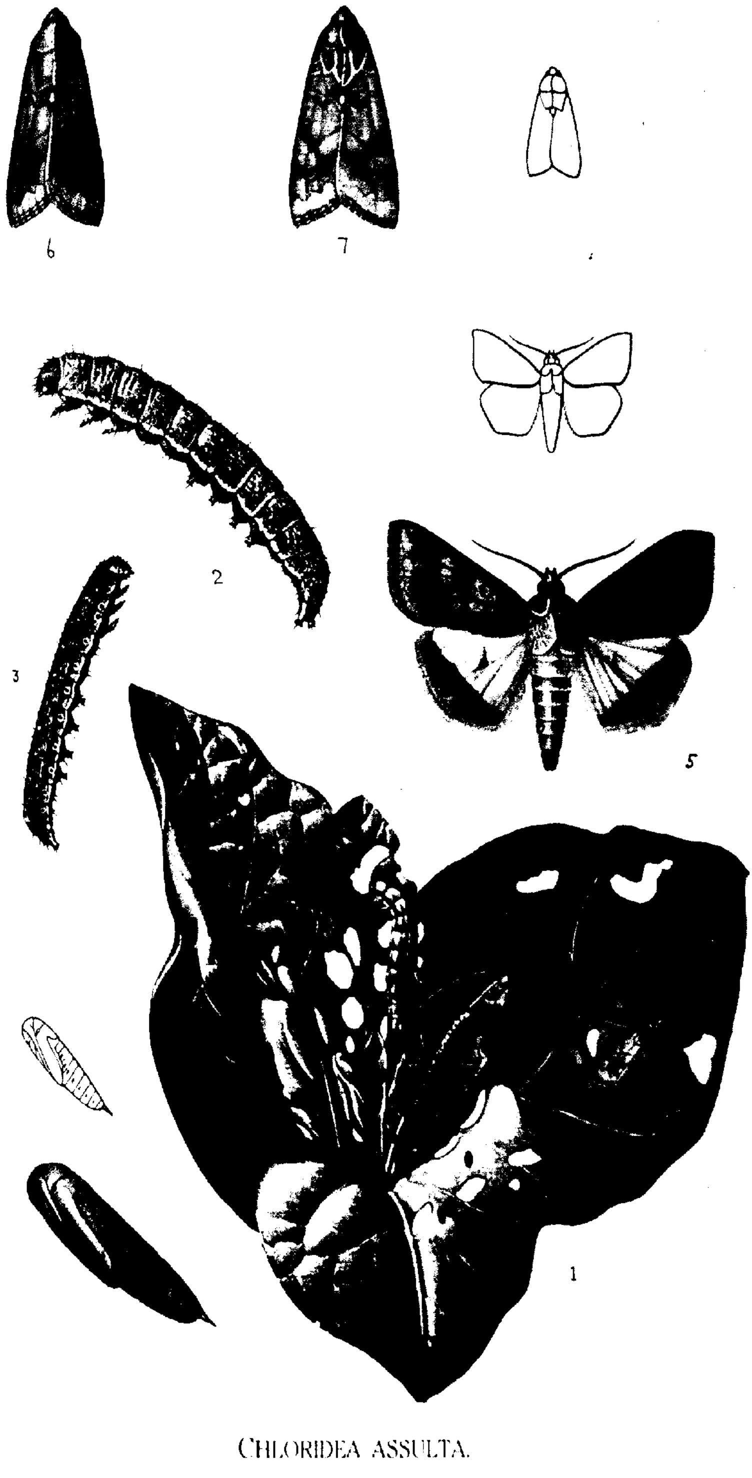
Fig. 1 shows a plant with typical damage caused by the two life-size caterpillars seen feeding on the leaves; a moth is also seen at rest on a leaf.

Figs. 2 and 3 show two different colour-forms of the caterpillar, enlarged.

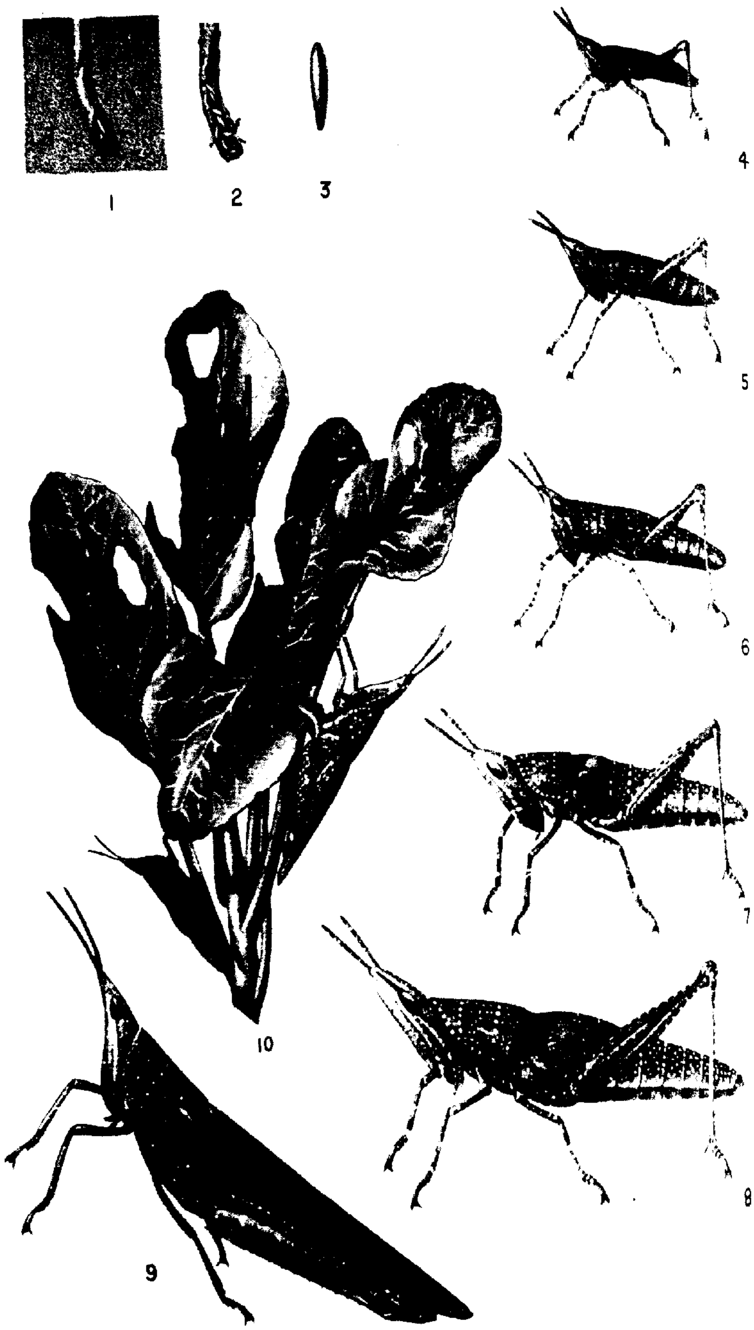
Fig. 4, pupa.

Figs. 5, 6 and 7, moths.

The outline figures show natural sizes.



CHLORIDEA ASSULTA.



ATRACTOMORPHA CRENULATA.

Atractomorpha crenulata, Fb.

Figs. 1, 2 and 3, egg cluster, in soil, removed from soil and one egg enlarged.

Figs. 4 to 9 show the development of the hopper (enlarged) until it attains the fully winged adult stage.

Fig. 10 a cauliflower shoot with grass-hoppers on it (natural sizes).

The frass is quite prominent on the leaves and the caterpillars can be traced easily and picked by a man walking among the plants. **Mr. Ghosh.**

Prodenia litura [" South Indian Insects," p. 377, tab. 19] is a serious pest of tobacco in many localities, especially in Western India and Madras. We have examples reared on tobacco at Nadiad, Anand, Surat, Rangpur, Muzaffarpur, and Pusa, but it is a polyphagous species which we have dealt with already under castor, maize, jute and various other crops. In the case of tobacco, the caterpillars may be hand-picked, especially when they are young and before they have dispersed. **Mr. Fletcher.**

In Madras *Prodenia litura* is very common on tobacco. **Mr. Ramakrishna Ayyar.**

Prodenia does a good deal of damage to tobacco in Bombay also. **Mr. Jhaveri.**

Plusia signata [" South Indian Insects," pp. 392-393, fig. 259] has been recorded on tobacco in Southern India, but there is some doubt regarding identification and the species concerned may be *P. chalcytes*. We have, however, no record of *P. chalcytes* on tobacco. In any case, this *Plusia* is unimportant as a pest. **Mr. Fletcher.**

Plusia nigrisigna occurs throughout India and is a sporadic minor pest, chiefly of gram. It has also been reared on tobacco at Pusa but is not known as a pest of this crop.

Atractomorpha crenulata is described and figured in " South Indian Insects," p. 528, fig. 421, but this figure is a poor one and we have lately issued a coloured plate showing the complete lifehistory. The eggs are laid in the ground in a mass, and the young hoppers feed on the leaves until they are full-grown. *Atractomorpha crenulata* is widely distributed in India and is chiefly a pest of young plants, attacking, besides tobacco, cabbages, cauliflower and various other plants. Tobacco in its later stages of growth is not exempt from attack, however, and the grass-hoppers, both immature and adult, may be seen commonly on the plants, eating patches out of the leaves. In the case of a crop such as tobacco it is comparatively easy to catch the hoppers either by hand or in small nets.

The seed-capsules of tobacco are damaged by :—

Heliothis assulta.
Heliothis obsoleta.
Nysius inconspicuus.
Gallobelicus crassicornis.

Heliothis assulta has just been considered as a leaf-eating pest, but the caterpillars sometimes bore in the seed-capsules also and may do damage in this way. If they are picked systematically from the leaves, the damage will be reduced.

Heliothis obsoleta also bores at times in the capsules. Hand-picking is the only remedy.

Nysius inconspicuus is supposed to occur on tobacco and *N. minor* has been recorded in "Indian Insect Life," p. 687, as found on tobacco abundantly, but we do not seem to have any exact records and the identification of these bugs appears to require revision.

Gallobelicus crassicornis ["South Indian Insects," pp. 490-491, fig. 377] is found commonly, at times abundantly, on the tender shoots and flower-heads and seed-capsules of tobacco and is a minor pest throughout India. The adults are fairly active and are probably best dealt with by catching in hand-nets and shaking the affected plants over pans of oil and water.

The stems of tobacco plants are damaged by the caterpillar of *Phthorimæa heliopa* ["South Indian Insects," pp. 454-455, tab. 43] which bores in the stem, causing a characteristic gall-like swelling. It attacks seedlings as well as grown plants, and is especially bad on the second crop when this is taken after a first cutting. In most districts this insect seems to be a minor pest, sporadically serious, but in Western India it is apparently a major pest. It occurs throughout the Plains of India and in Ceylon, but we have no records from North-Western India. Our records are from Hanguranketa (Ceylon), Coimbatore, Shevaroy Hills, Hagari, Penukonda (Anantapur District), Tharsa, Gujarat, Anand District, Pusa and Rangpur. As regards control, this is best effected by removal and burning of all attacked plants in nurseries and by careful cleaning up of all stumps and stray plants after harvest. In some districts the cultivators slit up the gall with a sharp knife to kill the caterpillar.

In North Gujarat, *Phthorimæa heliopa* is very common. The caterpillars are first noted in the seed-beds. This insect never kills the plant whose growth only is checked. I have seen plants, containing as many as fifteen caterpillars, but not killed. As regards control, the ploughing of the fields after harvest, with removal of all stubble, is found useful in the Kaira District, N. Gujarat.

Schizodactylus monstrosus ["South Indian Insects," pp. 533-534, fig. 427] was considered under indigo. It does damage to tobacco at times but only casually and incidentally to its burrowing in the ground.

Sucking insects found on tobacco, other than the bugs found on the shoots and already mentioned, are few in number, but Aphids occasionally occur in some numbers and may be minor pests.

Aphids are very bad on tobacco in Tanjore and Coimbatore.

Opium Poppy (*Papaver somniferum*).

The cultivation of the Opium Poppy is now very much restricted **Mr. Fletcher.** and there seems to be little on record regarding the pests which attack this plant. On my list I have the following insects :—

Heliothis obsoleta.
Euxoa spinifera.
Agrotis ypsilon.
Prodenia litura.
Tanymecus indicus.
Atmetonychus peregrinus.
Chrotogonus spp.
Thrips.

Heliothis obsoleta has been recorded as attacking poppy heads in the United Provinces. If in numbers this insect would be likely to do considerable damage and would be difficult to check except by hand-collection of the larvæ and anyway the heads attacked would be spoilt.

Euxoa spinifera is on my list but we do not seem to have any definite vidence that it attacks poppy and its status in this connection is doubt-al. The larva usually feeds at the roots of plants.

Agrotis ypsilon has been recorded in "Indian Museum Notes," 'ol. V, p. 184, as "doing great damage to the poppy crop in particular ocalities in the Shahabad District." We have one of these original Shahabad specimens, so that the identification is confirmed. Otherwise ve do not know *A. ypsilon* as a pest of poppy, although it is likely to e so, especially of young plants. This species was discussed under gram. In a case of regular serious attacks in any areas, control could probably be secured by the use of Andres-Maire traps.

Prodenia litura also feeds on poppy leaves but whether it is a pest we do not know. If it does damage, control should aim at collection of egg-masses and batches of young larvæ.

Tanymecus indicus was found on poppy at Burhampur, in the United Provinces, but we do not know of it as a pest.

In "Indian Museum Notes," Vol. III, p. 12, there is described and figured an unnamed weevil which was reported in December 1891 as doing considerable damage to poppy plants in Partabgarh and Ghazipur. Possibly this was *T. indicus.*

Atmetonychus peregrinus [Marshall. *Fauna of India. Curculionidæ,* Vol. I, pp. 112-113, fig. 37] was found on poppy at Fyzabad, in the United Provinces, but it is not a pest as far as we know. It occurs from Bengal to the Punjab and has been found on *Zizyphus jujuba*, on potato leaves, and on *bhindi* (*Hibiscus esculentus*).

Chrotogonus, and doubtless other grasshoppers, attacks young poppy plants. Control by bag-netting.

Thrips is also said to occur on poppy, especially on young plants, but we know nothing of the species concerned or the damage done.

Mr. David, can you tell us any more about Poppy Pests in the United Provinces ?

In the United Provinces cutworms are bad on opium poppy. Otherwise we do not know of any pests.

We do not seem to have much information about opium poppy pests. I will send a fieldman from Pusa to examine and collect material in the poppy districts of the United Provinces.

INDIAN HEMP (*Cannabis sativa*).

We seem to have very little information also on pests of Indian Hemp. On my list I have only :--

Heliothis obsoleta.

Pempheres affinis.

Heliothis obsoleta has been reared in Madras on Indian Hemp.

In Bengal *Heliothis obsoleta* is a bad pest, eating the leaves and cutting the topshoots.

Pempheres affinis was also reared at Pusa, a few specimens only, from *Cannabis* stems. It occurs every year on wild plants but does no damage.

Diacrisia obliqua also occurs on the leaves in Bengal, but is not very common.

In Bengal Red Spider is very bad on Indian Hemp. This is the worst pest we have in Bengal on this plant.

HENBANE (*Hyoscyamus niger*).

[*Khorasani ajwain* -Hind.]

Henbane grows wild in the Western Himalayas from 8,000 to 11,000 feet, and I believe that it is grown to some extent for medicinal purposes. The only pests I have noted are Aphids.

BABUL (*Acacia arabica*).

Babul may be considered here, as the bark is used to some extent for tanning and it is also a firewood tree of some importance in some districts. We could make up a long list of insects found on *babul*, but need only note a few now.

The leaves are often eaten to some extent by the larvæ of *Clania crameri* [" South Indian Insects," p. 448, fig. 325] whose large larval cases are easily seen and hand-picked.

Borers are more important, as they do more damage. We know :

Psiloptera fastuosa.
Cœlosterna spinator.
Stromatium barbatum.

Psiloptera fastuosa ["South Indian Insects," p. 297, fig. 140] is common in *babul* plantations and perhaps bores in this tree, although it does not seem to have been actually noticed as doing so. Stebbing [*Indian Forest Coleoptera*, pp. 199-200, tab. 11] records the beetles of *Ps. fastuosa* as injuring the stem of *babul* trees at Buldana by peeling off the bark.

Cœlosterna spinator ["South Indian Insects," p. 325, fig. 180] has been recorded as boring in *babul* but Stebbing [*Indian Forest Coleoptera*, pp. 358-362, tab. 25] records *C. scabrator* (under the name *scabrata*) and states that *spinator* is probably a variety of *scabrator*, which may be the case. The grubs bore in the stem and down into the roots and may do considerable damage.

Stromatium barbatum ["South Indian Insects." pp. 321-322, fig. 175] has been recorded from Poona as found on *babul*, but I do not know whether it attacks living trees.

Of sucking insects on *babul* the most important is a Scale-insect, *Anomalococcus indicus*, which is abundant on *babul* at Coimbatore and sometimes occurs in such numbers as to cause the death of the trees attacked. It is attended by *Camponotus compressus* and one method of control is to ring the trees with a sticky mixture so as to keep these ants away. This Scale is parasitized by *Eublemma scitula* ["South Indian Insects," p. 381, fig. 242 and p. 199, fig. 85] and by a small fly which is probably a species of *Cryptochætum* and I have actually seen the *Camponotus* standing over a Scale and warding off the attempted attack of one of these small parasitic flies.

Oxyrhachis tarandus ["Indian Insect Life," p. 731, tab. 78] is also common on *babul* and does some damage to young shoots by thrusting in its eggs and by the sucking of the bugs ; but how far it is an actual pest is doubtful.

We will next take the various

CRUCIFEROUS CROPS

of which the first are the various species of

MUSTARDS (*Brassica juncea.*
,, *dichotoma.*
,, *campestris*).

Leaf-eating insects on mustards include :—

Athalia proxima.
Athalia leucostoma.
Plu'ella maculipennis.
Crocidolomia binotalis.
Hellula undalis.
Flea Beetles.

Athalia proxima [Entomological Memoirs, Vol. I, pp. 357-370, tab. 20] occurs in the Plains of India north of a line from Bombay to Calcutta and also in the Hill Districts of Southern India. In Bihar it occurs only in the winter months but in Bombay it is found during the South-West Monsoon. The life-history and habits are fully described in the Memoir and the only additional facts are that the parasites bred from *A. proxima* have since been identified and described in the *Fauna of India* volume on Ichneumonidæ as *Exacrodus populans* [*l. c.*, pp. 330-331, fig. 93]. *A. proxima* occurs regularly on mustards but does comparatively little damage, so that no control measures have been required.

Athalia leucostoma occurs in the Kohat Valley, in the North-West Frontier Province, where I obtained adults in May 1916 flying in a field of mustard.

Plutella maculipennis [" South Indian Insects," p. 164, fig. 340] occurs commonly on mustard, the caterpillar eating holes in the leaves. When on the leaves it is unimportant, but the caterpillars also bore the pods, when it may do damage.

Crocidolomia binotalis [*l. c.*, p. 137, fig. 313] occurs throughout India, Burma and Ceylon, usually as a minor pest when on the leaves, but occasionally serious, webbing the whole plant. The life-history was shown in a coloured plate issued last year. We have specimens reared on mustard from Surat, Pusa and Lyallpur. The caterpillar also bores the pods, when it does serious damage. Control should include destruction of webbed portions of first-attacked plants together with spraying with stomach-poison. It should be taken in hand early before the pods are formed.

Hellu'a undalis [*l. c.*, pp. 137-138, fig. 314] occurs throughout India, Burma and Ceylon as a minor pest of mustards, sometimes destructive to young leaves, webbing these over and killing them back. Destruction of first-attacked plants seems the only practical control measure.

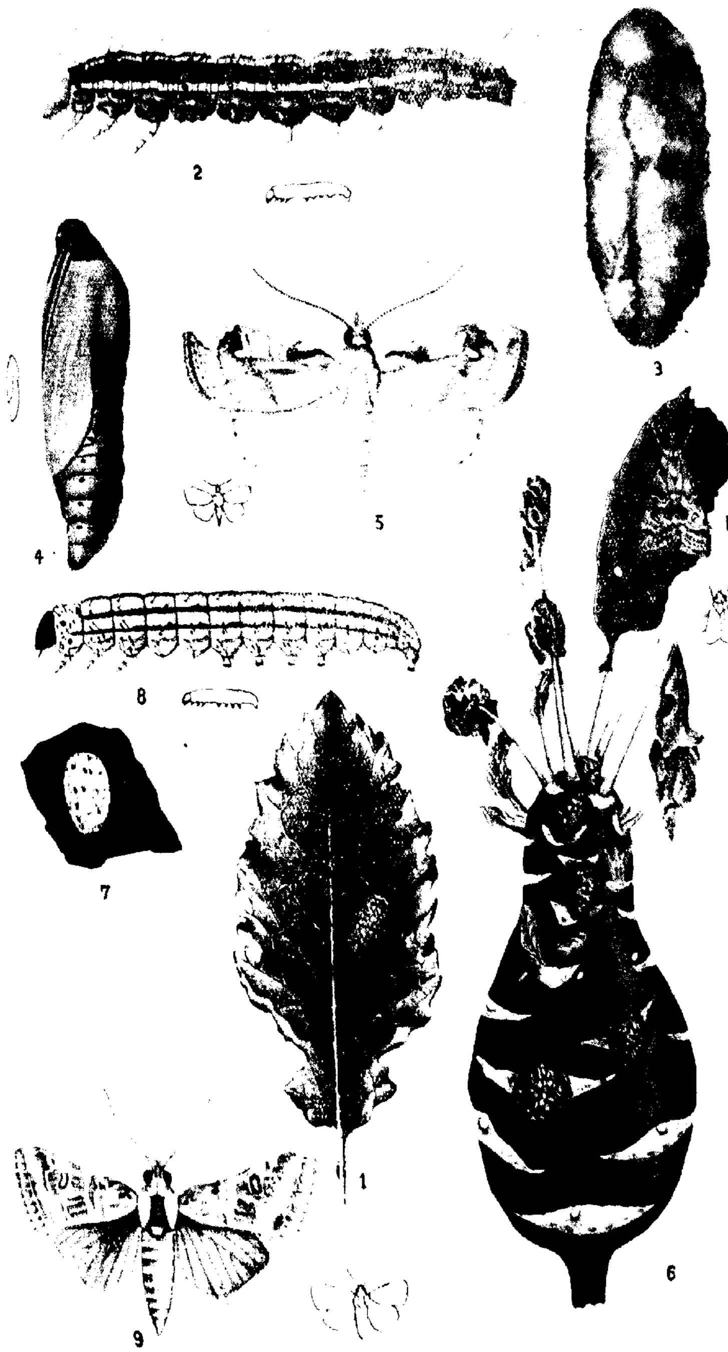
Flea Beetles occur on mustards and may be *Phædon brassicæ* but we seem to have no specimens definitely identified. Contro' by catching in hand-nets or bag-nets when the state of the crop permits.

Crocidolomia binotalis, Zell. (*Figs. 1—5.*)

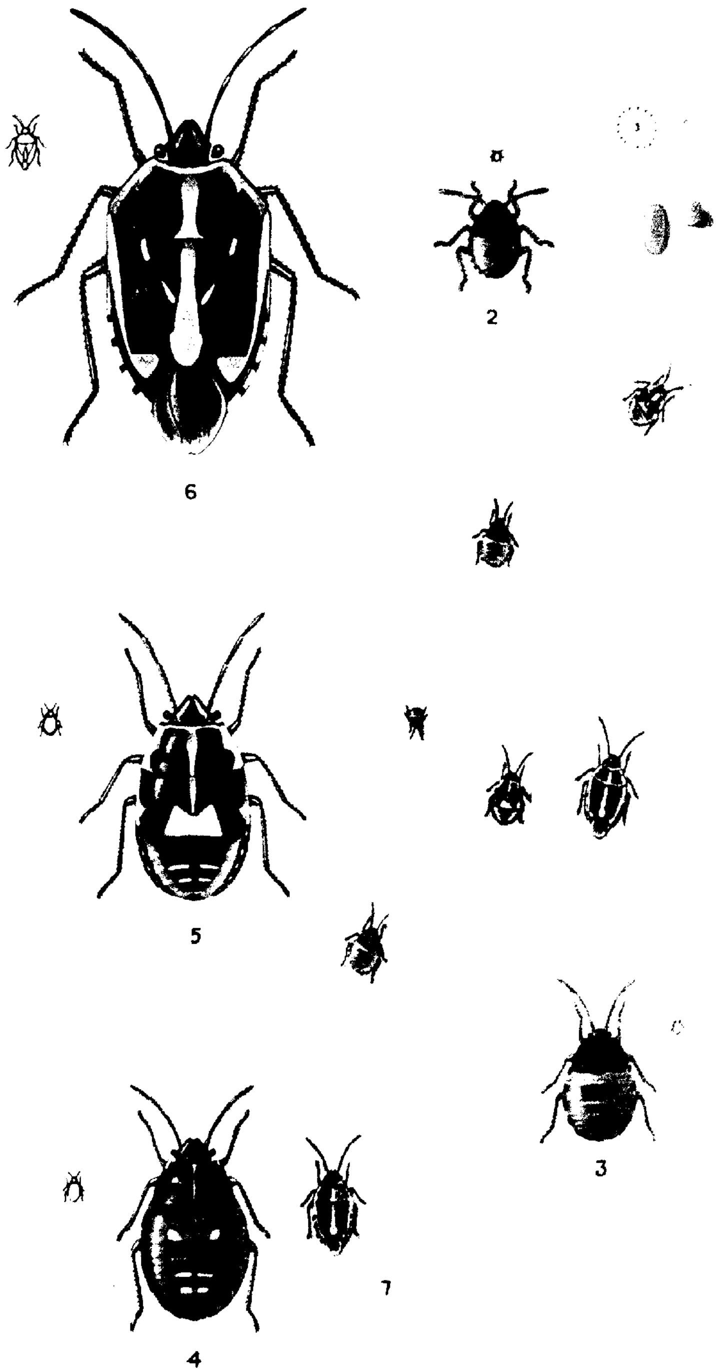
Fig. 1 shows an egg-mass on a mustard leaf;
Fig. 2 the larva (magnified);
Fig. 3 the cocoon (magnified);
Fig. 4 the pupa taken out of the cocoon, and
Fig. 5 the moth as seen flying.

Hellula undalis, F. (*Figs. 6—10.*)

Fig. 6 is an affected knol-kohl showing how eggs are laid, how the caterpillars damage the leaves and how they bore into the stem, the places where the caterpillars have bored being indicated by masses of webbed-up excreta thrown out;
Fig. 7 is a single egg magnified;
Fig. 8 is the grown-up caterpillar (magnified);
Fig. 9 the moth as seen flying, and
Fig. 10 is the same while it rests (both magnified).
Figures in outline show the natural sizes.



CROCIDOLOMIA BINOTALIS & HELLULA UNDALIS.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2
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7
4

Bagrada picta, Fb.

Fig. 1, Egg, one freshly laid and the other (reddish) about to hatch (both magnified);
Figs. 2-5, Nymphs in different instars (magnified);
Fig. 6, Adult bug (magnified).
Fig. 7, A cauliflower leaf with nymphs and adults (magnified).
Figures in outline show the natural sizes.

Sucking insects found on mustards include :—

Bagrada picta.
Eurydema pulchrum.
Aphis brassicæ.

Bagrada picta is described and figured in "South Indian Insects," p. 473, tab. 2, fig. 10 and we have since issued a plate showing its life-history. It is widely distributed throughout India and sometimes occurs in large numbers on mustards when grown as field crops. Damage is done chiefly in the later stages of growth of the plant, by which time the bugs have multiplied into large numbers, which are seen massed especially on the seed-pods. Control, when the bugs are in large numbers, is not easy, as the bugs are active and the adults readily take to wing. They may be collected in hand-nets and the immature stages shaken into pans of oil and water.

Eurydema pulchrum [*Fauna of India, Rhynchota*, Vol. I, pp. 190-191, fig. 114] occurs in Assam and Burma and has been reported to attack mustard in Burma. It is probably similar to *Bagrada picta* in habits and control methods will be the same.

Mr. Shroff. *Eurydema pulchrum* is a bad pest of mustard in the Hill Districts of Burma.

Mr. Fletcher. *Aphis brassicæ* is a serious pest of mustards throughout India. Its abundance is often reported as correlated with dull weather and possibly this is so and due to the fact that its natural enemies, chiefly Coccinellids, become inactive in dull, wet or cold weather. I have already called your attention, under the heading of wheat, to the importance of the increase of these predators on the Aphids on mustards. As regards means of control, other than by natural enemies, I do not see that much is possible on a field-scale.

Mr. Ghosh. Against Aphids on mustards the most important thing to do is to keep up the vigour of the plants. Vigorous plants have been observed to escape the bad effects due to attack by Aphids as well as by *Crocidolomia* when adjacent less vigorous plants were badly attacked.

Mr. Fletcher. The seed-pods of mustards are attacked by *Crocidolomia binotalis* and *Plutella maculipennis*, both of which we noticed as eating the leaves also. The main damage, however, is done to the pods and this may be serious especially in the case of *Crocidolomia* which also attacks the flowers. The only means of checking this seems to lie in prompt measures in combating the caterpillars as soon as they are noticed on the crop ; if they can be checked whilst still on the leaves, there is less likelihood of their being present in destructive numbers when the pods are formed later on. Varieties which flower late, so that the pods are formed late, are

more liable to attack than early-flowering mustards, because *Crocidolomia* is likely to be present in larger numbers later in the season.

CABBAGE (*Brassica oleracea.*)

The pests of cabbage are, generally speaking, very similar to those of mustard, although we have a longer list of pests on cabbage, probably largely due to the fact that this is a garden crop.

Cabbage seedlings are eaten by :—

Dorylus orientalis.
Athalia proxima.
Chiloloba acuta.
Psylliodes tenebrosus.
Brachytrypes portentosus (achatinus).

Dorylus orientalis [" South Indian Insects," p. 274, fig. 111] is a common pest of seedlings in most districts, this ant attacking them from below-ground in the same way as a termite. Watering the plants with Crude Oil Emulsion or similar deterrent will ward off such attack temporarily.

Athalia proxima [Entomological Memoirs, Vol. I, pp. 357-371, tab. 20] occurs on the leaves, which are eaten by the larva. Dusting the plants with kerosinized ashes is usually effective in checking and averting attack.

Chiloloba acuta [" South Indian Insects," p. 284, fig. 121] has been reported from Pachmarhi as injuring cabbage seedlings in the grub stage. Watering with Crude Oil Emulsion or other deterrent and search in the soil around the plants are indicated as control measures.

Psylliodes tenebrosus is a small Halticine beetle which was reported from Jeolikote and Bhim Tal as doing extensive damage to seedling cabbages. Sprinkling the plants with kerosinized ashes should keep away pests of this sort.

Brachytrypes portentosus (achatinus) [" South Indian Insets " p. 536, fig. 430] is widely distributed in Bengal and Bihar and damages cabbage seedlings after transplantation. In the case of garden cultivation, such as cabbages, the best means of control is to hunt down and kill these crickets in their burrows, which are usually easy to find especially in the evening when the crickets emerge. They may be flooded out with a little water and killed or, if a burrow is found occupied, a little petrol may be poured in and the earth stamped down.

The leaves of well grown cabbage plants are eaten by :—

Athalia proxima.
Pieris brassicæ.
" *canidia.*
Agrotis ypsilon.
Prodenia litura.
Plusia orichalcea.
Crocidolomia binotalis.
Hellula undalis.
Plutella maculipennis.
Monolepta signata.
Phyllotreta chotanica.
Flea beetles.
Tanymecus circumdatus.

Athalia proxima was considered under seedlings. It also occurs on the leaves of grown plants but does little damage to these as a rule.

Pieris brassicæ is a bad pest in most parts of Northern India. It is found all along the Himalayan Range from Chitral to Bhutan and the Hills of Assam, penetrating into the Plains in the winter months in an area about one hundred miles wide and parallel with the hills, straggling as far south as Cuttack. At Pusa, as I told you the other day, adults appear regularly every year about 1st February and two or three broods occur in February and March, the butterflies all disappearing about the end of April. At Peshawar the butterflies appear in October and are on the wing and breed until about the end of May. We have examples from Bhagalpur, Pusa, Lyallpur, Akalgarh (Punjab), Peshawar, Abbottabad and Shillong. It is a serious pest of cabbage. The life-history is described in the *Agricultural Journal of India* for January 1912 and again in *Entomological Memoirs*, Vol. V, pp. 20-26. Control is comparatively easy if due precautions are taken, as the egg-masses and batches of young gregarious larvæ are easily seen and collected ; if the larvæ are left until they scatter, control becomes more difficult and the damage done is also greater.

Pieris canidia occurs commonly in the Hill Districts throughout India and Burma. The caterpillar is said to damage cabbages at Maymyo, in Upper Burma, but the record requires confirmation.

Agrotis ypsilon occurs fairly commonly on cabbages and does considerable damage when it does occur by boring into the head and often spoiling the whole plant for food. It also attacks seedlings as a regular cut-worm, when it can be grubbed out of the adjacent soil. When inside the grown head, however, it rests there and does not go into the

soil in the daytime and the only thing to do is to extract it, if possible, before much damage has been done.

Prodenia litura [" South Indian Insects," p. 377, tab. 19] attacks cabbages as it does practically all low-growing plants, but is not much of a pest, eating only the outer leaves.

Plusia orichalcea is described and figured in " South Indian Insects," pp. 393-394, fig. 260, and we have since issued a coloured plate showing the life-history. It is common throughout India and the caterpillar is often found on cabbage, but it is a very minor pest of this crop.

Crocidolomia binotalis [*l. c.*, p. 437, fig. 313] occurs commonly on cabbage but is chiefly a pest of plants kept for seed. We discussed this under mustard and there is no more to add, but control on a garden crop such as cabbage is obviously easier than on mustard.

Hellula undalis [*l. c.*, pp. 437-438, fig. 314] also occurs as a minor pest of cabbages, sometimes serious. This also was discussed under mustard and the same remark applies as to the last-named species.

Plutella maculipennis [*l. c.*, p. 464, fig. 340] occurs throughout the whole World wherever cabbages are grown by man and is a regular minor pest of this crop, eating holes in the leaves. The simplest remedy in this case is to squash the caterpillars and pupæ on the leaves. The caterpilla· also bores into the heads, eating through several layers of leaf, and in this case the leaves may be opened up and the caterpillar squashed.

Monolepta signata [*l.c.*, p. 310, fig. 159] occurs throughout India, usually as a minor pest on cabbage. The beetles may be caught in hand-nets.

Phyllotreta chotanica is a small blue-black Halticine beetle found at Pusa in small numbers on cabbage. It is scarcely a pest. It occurs at Mandalay.

Other Flea-beetles, which may or may not be *Phædon brassicæ*, are also found commonly.

Tanymecus circumdatus has been found on cabbage at Lahore, but we do not know it as a pest.

Opatrum beetles were seen on two occasions eating the leaves of cabbage and cauliflower at Dacca, in Bengal.

A yellow-striped Flea-beetle occurs on cabbage in the Katha District, Burma. It is *Phyllotreta vittata*.

The stems of cabbages are sometimes attacked, especially in the Hills, by *Euxoa segetum* [" South Indian Insects," p. 375, fig. 237], which is generally a very difficult insect to check. The best thing to do, in the case of cabbages, is to grub out the caterpillars from the soil around the plants.

A termite, *Microtermes obesi* (*anandi*), has also been found attacking the roots and portions of stems underground of cabbages at Pusa and the plants attacked were apparently quite healthy. Watering with a deterrent, such as Crude Oil Emulsion, is indicated in such cases.

A few sucking insects are found on cabbage, but the only one we need notice is *Bagrada picta*, which we considered under mustard. On cabbage it usually occurs late in the season and is generally only a pest on old plants, especially those kept for seed. Catching the bugs in hand-nets and spraying with a contact insecticide form the most effective control-measures.

Mr. Shroff. In Burma *Bagrada picta* attacks cabbage seedlings also and this bug is rather a serious pest.

Mr. Fletcher. In India, as I said, it usually occurs only on old plants which are sometimes literally covered with these bugs. *Bagrada picta* is distinctly a sporadic insect in its appearance and in some years is very abundant in districts where it is usually scarcely noticed. It would be interesting to know the exact causes underlying such sporadic outbreaks.

CAULIFLOWER (*Brassica oleracea cauliflora*).

Cauliflower is botanically a mere cultivated variety of cabbage and its pests are practically the same, so we need only run over them briefly.

Cauliflower seedlings are attacked by :—

Dorylus orientalis.

Termites.

Brachytrypes portentosus (*achatinus*).

Chiloloba acuta, larva.

Psylliodes tenebrosus.

Dorylus orientalis and Termites attack the seedlings below the ground and can only be kept away by deterrents. As regards *Dorylus orientalis*, this occurs every year at Pusa and of various soil insecticides we have tried against this, our experience has been that Crude Oil Emulsion is the best. The same remark applies to termites, the species concerned at Pusa being *Microtermes obesi* (*anandi*).

Brachytrypes portentosus was considered under cabbage and there is nothing special to say about it as regards cauliflower.

The grubs of *Chiloloba acuta* were reported from Pachmarhi as attacking cauliflower seedlings.

Psylliodes tenebrosus was reported as doing great damage to seedlings at Jeolikote in November 1909 and as having devastated a garden at Bhim Tal at the end of February 1912.

Leaf-eating insects on cauliflower include :—

Pieris brassicæ.
Plutella maculipennis.
Plusia signata.
„ *orichalcea.*
Crocidolomia binotalis.
Hellula undalis.
Agrotis ypsilon.
Athalia proxima.
Monolepta signata.
Phyllotreta chotanica.

All of these were included under cabbage and there is little to add here except that the larva of *Hellula undalis* bores the stem of cauliflower and that *Phyllotreta chotanica* occurred in large numbers at Pusa in March 1916.

In addition to the foregoing leaf-eaters, we have :—

Plusia ni.

Plusia ni has been bred at Pusa and Lahore on cauliflower and at Surat and Kumbhariya (Surat) on cabbage, but it is scarcely a pest.

Phyllotreta vittata also occurs on cauliflower in the Katha District, Burma.

The flowers of cauliflower are attacked by Aphids ; but these are scarcely pests as a rule ; and the seed-pods are attacked by *Bagrada picta* in the same way as cabbage.

KNOL-KOHL (*Brassica oleracea caula-rapa*).

[*Kohl-rabi.*]

The only important pest found on knol-kohl is *Hellula undalis* which was considered under mustard.

Hellula undalis feeds on the leaves, webbing them up, and also bores in the root. In the coloured plate, a *knol-khol* is shown in figure 6, which shows how the eggs are laid, and how the caterpillars web up the leaves and bore in the tuberous root, the entrances of their tunnels being marked by the masses of extruded frass. Prompt destruction of the first lot of larvæ is the only control-method.

TURNIP (*Brassica* sp.).

Turnip leaves are attacked by :—

Athalia proxima.
Crocidolomia binotalis.
Flea Beetles.

All these have just been considered, and there is no more to add. These insects do not appear to be very serious pests as a rule.

Bagrada picta also occurs on turnip in the same way as on cabbage.

BEET-ROOT (*Beta vulgaris*).

The leaves are attacked by :—

Monolepta signata.
Tanymecus indicus.
Hellula undalis.

All of these have been discussed before. *Tanymecus indicus* was once found bad at Pusa and *Hellula undalis* bores in the roots also.

SUGAR-BEET.

The form of beet-root cultivated for sugar has been tried in the North-West Frontier Province and *Laphygma exigua* caterpillars occurred on the leaves in some numbers. This may prove a pest if the cultivation is extended.

Silver Beet is grown as a fodder crop at Coimbatore. *Prodenia*, *Laphygma* and other common pests attacked this crop very badly. **Mr. Ramakrishna Ayyar.**

RADISH (*Raphanus sativus*).

The pests of radish are very similar to those of mustard and cabbage. *Hellula undalis*, and sometimes also *Crocidolomia*, bore in the roots, and on the leaves we get :— **Mr. Fletcher.**

Athalia proxima.
Diacrisia obliqua.
Laphygma exigua.
Plusia orichalcea.
Crocidolomia binotalis.
Hellula undalis.
Plutella maculipennis.
Monolepta signata.
Bagrada picta.

We have already gone over all these and there is nothing special to add as regards radish.

LETTUCE (*Lactuca sativa*).

The pests noted on lettuce leaves include—

Pieris brassicæ.
Oxyptilus lactucæ.

Pieris brassicæ has occurred on lettuce at Pusa rather late in the season, but is not a regular pest.

Oxyptilus lactucæ was reared from larvæ sent to us from Dehra Dun as found on lettuce. It is an undescribed species, in general appearance very like *Sphenarches caffer*. Whether it does any damage we do not know. It was only sent in once.

Cress (*Lepidium sativum*).

The leaves of cress are eaten by :—

Athalia proxima.
Crocidolomia binotalis.

Both of these were considered under mustard and there is no more to add regarding their occurrence on cress.

OTHER VEGETABLES AND CONDIMENTS

Potato (*Solanum tuberosum*).

Potato seedlings are attacked by :—

Gonocephalum (*Opatrum*) spp.
Agrotis ypsilon.
,, *c-nigrum.*
Euxoa segetum.

Gonocephalum (*Opatrum*) of various species, generally referred to *G. depressum*, are said to eat sometimes into the stems of older plants and also attack seedlings, but the amount of damage done and its real cause seem to require further investigation. The adult beetles seem to feed only on decaying vegetable matter.

Agrotis ypsilon occurs throughout Northern India and mostly in a belt of about one hundred miles wide and parallel with the Himalayas, straggling as far as Nagpur and Jessore. Apparently not known in Western or Southern India, but probably occurs, as it is found in Ceylon. It has been reared on potato at Jubbalpur, in the Central Provinces, and probably occurs in most potato-growing districts in Northern India, the larva cutting the young plants and eating into the stems of larger plants. Control on a large scale by Andres—Maire traps and in garden plots by grubbing up the caterpillars.

Agrotis c-nigrum occurs at Jubbalpur, usually every year, as a pest of potato. Control by hand-collection of the caterpillars.

Euxoa segetum ["South Indian Insects," p. 375, fig. 237] occurs throughout India, Burma and Ceylon, more commonly in the Hill Districts, and is often a serious pest of potato in the Hills. In the Shevaroy Hills there was a very bad attack on potato in 1912. Control by grubbing

up the caterpillars is the best method as a rule. Spraying is not effective, as the caterpillars prefer to feed on the roots and underground portions of the stems.

Eating the leaves we find :—

Plusia orichalcea.
Monolepta orientalis.
Epilachna 28-punctata.
,, *12-stigma.*
Flea beetles.
Atmetonychus peregrinus.
Myllocerus subfasciatus.

Plusia orichalcea is scarcely a pest on potato.

Monolepta orientalis was found at Rangpur. Otherwise we do not seem to know this insect.

Epilachna 28-punctata and *E. dodecastigma* ["South Indian Insects," p. 292, tab. 6] both occur commonly on potato and sometimes do considerable damage in the Plains. Collection by hand of the insects in all stages and in bad cases spraying of the affected plants will provide control.

Flea-beetles occur commonly as minor pests, occasionally serious, but we know nothing of the species concerned. Collection by hand-nets, where necessary, will provide control.

Atmetonychus peregrinus was found on potato at Cuttack but was probably a mere casual visitor and not a pest.

Myllocerus subfasciatus is recorded on potato at Ootacamund, but we do not know how far it is a pest.

The sucking insects found on potato include :—

Nezara viridula.
Aphids.

Nezara viridula is figured in "South Indian Insects," pp. 473-474, fig. 352, and the life-history is shown in a coloured plate since issued. It may be observed that the coloration of both immature and adult bugs is very variable. *Nezara viridula* is fairly common on potato, usually occurring as a minor pest. The bugs may be collected in hand-nets.

Aphids are of common occurrence on the leaves and stems and considerable damage may be done at times, but control on a field scale is rather a matter for natural predators.

The roots and tubers are attacked by :—

Dorylus orientalis.
,, *labiatus.*

Dorylus orientalis ["South Indian Insects," p. 274, fig. 111] occurs in most parts of India and occasionally attacks the underground portions of potato plants. Watering with a deterrent, such as Crude Oil Emulsion, will drive them away temporarily.

Dorylus is very bad on potato in Assam. The ants bore the tubers and cut the roots.

Dorylus labiatus has been reported from Coorg as attacking potato in the same way as *D. orientalis*.

The stems of potato are bored by :—

Leucinodes orbonalis.
Phthorimæa operculella.

Leucinodes orbonalis was found boring in top-shoots of potato at Poona, but this habit is very unusual. [See Entomological Note 71, in Bulletin 59.]

Phthorimæa operculella was found to bore into shoots in confinement but this habit has not been noticed in the field in India.

BRINJAL (*Solanum melongena*).

Brinjal seedlings are attacked by :—

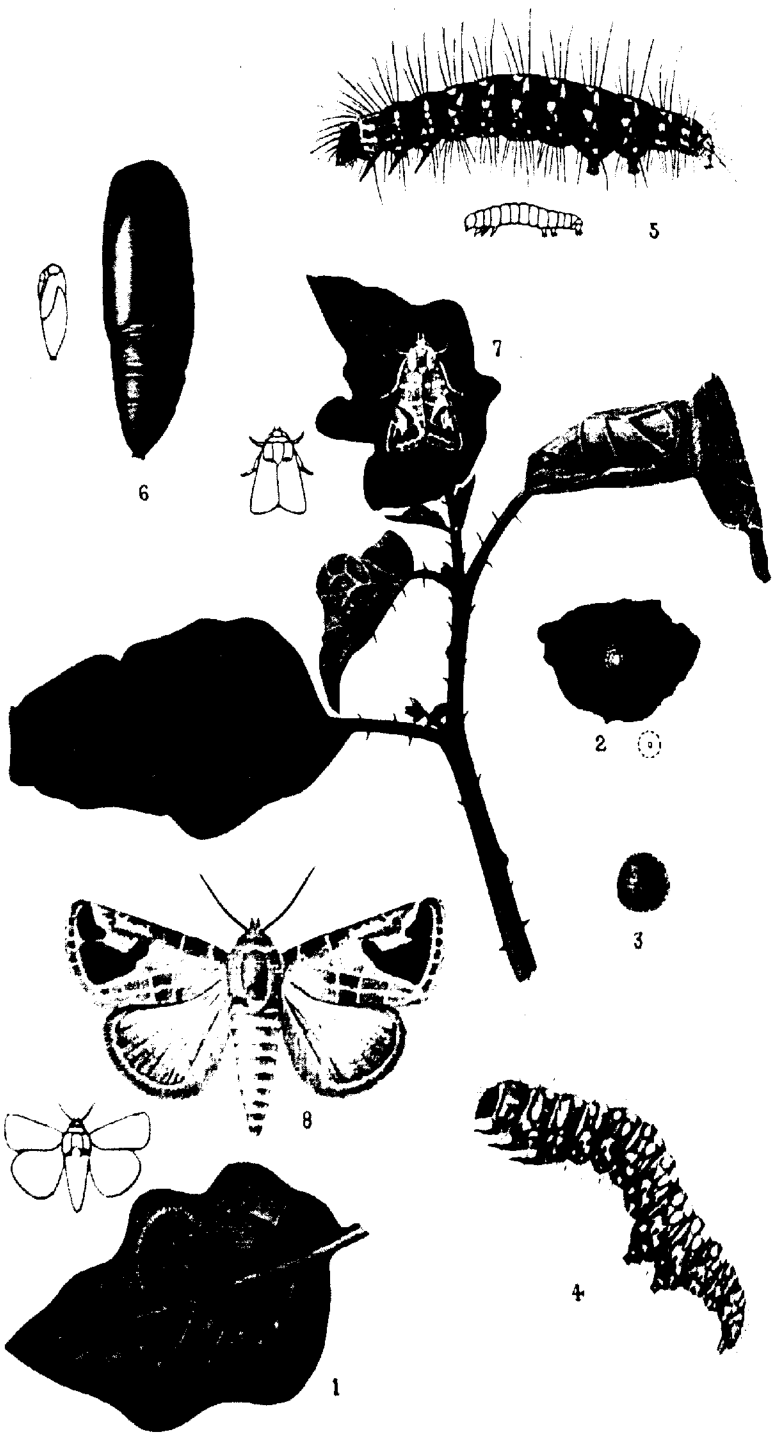
Solenopsis geminata.
Flea-beetles.
Halticus minutus.

Solenopsis geminata ["South Indian Insects," pp. 274-275, fig. 112] was reported as damaging brinjal seedlings in Calcutta. In such cases the ants could probably be kept away by sprinkling the plants with kerosinized ashes.

Flea-beetles and *Halticus minutus* attack seedlings in the seed-beds and may kill the young plants, whose leaves become spotted with yellow. Control by hand-nets.

Brinjal leaves are eaten by :—

Epilachna 12-stigma.
,, *28-punctata.*
Myllocerus subfasciatus.
,, *blandus.*
Laphygma exigua.
Eublemma olivacea.
Plotheia nephelotis.
Acherontia styx.
Nephopteryx minutella.
Phycita clientella.
Pachyzancla bipunctalis.
Pterophorus lienigianus.


5
6
7
2
3
8
4
1

Eublemma olivacea, Wlk.

Fig. 1, two clusters of egg on a leaf.

Fig. 2, a single egg viewed from above.

Fig. 3, a single egg viewed from side.

Figs. 4 and 5, full-grown caterpillars, colour varieties.

Fig. 6, pupa.

Fig. 7, moth sitting on leaf.

Fig. 8, moth with wings spread.

The brinjal shoot shows a leaf newly attacked and another leaf in an advanced stage of attack.

The small outline figures indicate the natural sizes.

Phthorimœa blapsigona.

,, *ergasima.*

,, *operculella.*

Orthacris sp.

Atractomorpha crenulata.

Epilachna dodecastigma [" South Indian Insects," p. 292, tab. 6] and *E. 28-punctata* are always minor, often major pests, of brinjal, the larvæ and beetles both eating the leaves. The beetles may be collected by hand in all stages and spraying with a stomach-poison done when necessary.

Myllocerus subfasciatus [Marshall, *Fauna of India, Curculionidæ*, Vol. I, pp. 345-346] was found on brinjal at Saidapet, but is not a pest so far as we know. It was also found on potato at Ootacamund.

Myllocerus blandus [*l.c.*, pp. 333-334, fig. 101] occurred on brinjal at Lyallpur, and is recorded from Madras, Bengal, Bihar and Burma. It is not a pest so far as is known.

Laphygma exigua is not common on brinjal and cannot be called a pest of this plant.

Eublemma olivacea is described and figured in " South Indian Insects," pp. 380-381, fig. 241, and the life-history is shown in detail in a new coloured plate. The caterpillar feeds inside a folded leaf which is usually rolled from the tip upwards and the caterpillar feeds on the leaf-substance of the roll in which it is contained. Pupation takes place inside the rolled leaf, which is discoloured and thus conspicuous. This insect is a minor pest as a rule, but occasionally very destructive. The affected, rolled leaves should be hand-picked and burnt, and, in Northern India, all dry and old leaves should be burnt in the winter months. The caterpillar does not bore into shoots as stated in *Indian Insect Pests*, p. 166.

Plotheia nephelotis is an unpublished manuscript name of a Sarrothripine Noctuid which is a minor pest of brinjal, on which it has been reared at Calicut, Coimbatore, Tiruvallur, and Melrosepuram (Madras), Nagpur and Pusa, and at Hagari (Bellary District) on *Solanum xanthocarpum*, a wild solanaceous plant. This is evidently the same insect as that described in "South Indian Insects," p. 383, fig. 246, as the " Brinjal Sarrothripine." The caterpillar attributed to this species in " Indian Insect Life," p. 449, is probably the larva of *Eublemma olivacea* ; the caterpillar of the present insect is hairy and yellow and lives exposed on the leaves.

Acherontia styx [" South Indian Insects," p. 402, tab. 24] is common throughout the Plains of India and Burma as a minor pest of brinjal. The large caterpillars may be hand-picked.

Nephopteryx minutella was reared at Pusa in small numbers in August and September 1912 from caterpillars on brinjal leaves, but did not occur as a pest. It is recorded from South India, Ceylon and Burma.

Phycita clientella is recorded from Calcutta, Bombay and Ceylon. It has been reared at Pusa from larvæ rolling brinjal leaves, but has not occurred as a pest.

Pachyzancla bipunctalis (*ægrotalis*) occurs throughout India (except North-West) and Ceylon. It has been bred at Pusa on *Alternanthera sessilis* and on croton, and at Coimbatore on brinjal and in brinjal shoots. It does not seem to have been noted as attacking any crop-plant except at Coimbatore. [" South Indian Insects," pp. 440-441, fig. 317.]

Pterophorus lienigianus [" South Indian Insects," p. 445, fig. 322] occurs throughout India, Burma and Ceylon. It has been reared on brinjal at Coimbatore and in the Godavari delta but is scarcely a pest.

Phthorimæa blapsigona has been reared at Coimbatore, Saidapet and Nagpur from larvæ boring and feeding in flower-buds of brinjal. Probably widely distributed in the Plains of India as a minor pest of brinjal. It is also reported to bore into the fruits in Nagpur.

It bores into the flower-buds and is a bad pest of brinjal in the hot season in the Central Provinces.

Phthorimæa blapsigona is bad in brinjal buds in Madras also.

We have searched for it at Pusa but without success so far, so it is evidently not much of a pest in Bihar.

Phthorimæa ergasima, however, is another species which we have found at Pusa, where the caterpillars mine brinjal leaves in February and March. It is scarcely a pest and is probably widely distributed in the Plains of India.

Phthorimæa operculella was found at Dharwar mining brinjal leaves, as related in Entomological Note 77, in Bulletin 59.

Orthacris sp. [" South Indian Insects," p. 527, fig. 420] occurs in Southern India as a minor pest of brinjal leaves.

Atractomorpha crenulata [*l.c.*, p. 528, fig. 421] also occurs on brinjal as a minor pest. It may be hand-picked.

The buds of brinjal are attacked by *Phthorimæa blapsigona*, as we have just seen, and also by *Solenopsis geminata* [*l.c.*, pp. 274-275, fig. 112].

The fruits are bored by *Leucinodes orbonalis* [*l.c.*, p. 436, tab. 30, figs. 5-9], whose caterpillar bores in the fruits as a rule but is also found in the shoots. It is widely distributed throughout our limits and is a very bad pest. Collection and destruction of attacked shoots and fruits seems to be the only remedy. Besides brinjal, *L. orbonalis* has been found in *Solanum xanthocarpum*, a wild plant, and in *Solanum nigrum*, which is

used as a vegetable in Southern India, the fruits being steeped in salt and water and then dried in the sun.

The stems of brinjal, besides *L. orbonalis*, are bored by the caterpillar of *Euzophera perticella* [*l.c.*, p. 428, tab. 30, figs. 1-4], which is a serious pest. The affected plants and shoots wither and should be removed and destroyed.

Sucking insects on brinjal include :—

Aspongopus janus.

Anoplocnemis phasiana.

Urentius echinus.

Aphids.

Phenococcus insolitus.

Aspongopus janus ["South Indian Insects," pp. 476-477, fig. 358] is common throughout the Plains and is sometimes a minor pest of brinjal. The bugs may easily be hand-picked.

Anoplocnemis phasiana [*l.c.*, pp. 477-478, fig. 360] sometimes occurs in some numbers on brinjal but is scarcely a pest.

Collection by hand is the obvious remedy.

Urentius echinus [*l.c.*, p. 485, fig. 370] is common throughout the Plains and is sometimes a serious pest of brinjal, the leaves attacked turning yellow, drying up and falling off the plant. In garden areas spraying with a contact insecticide can be done.

Aphids are sometimes bad on brinjal but we do not know what is the species concerned.

Mr. Jhaveri. Aphids are very bad on brinjal leaves in North Gujarat.

Mr. Fletcher. *Phenococcus insolitus*, a Scale-insect, occurs in Southern India on brinjal and is sometimes very bad, covering the whole plant so that this looks white.

Mr. Ramakrishna Ayyar. *Phenococcus* is very bad on brinjal at Coimbatore.

TOMATO (*Lycopersicum esculentum*).

Mr. Fletcher. Tomato leaves are eaten by :—

Prodenia litura.

Epilachna 28-punctata.

" *12-stigma.*

Prodenia litura occasionally occurs but is not a usual or serious pest.

The two species of *Epilachna* are sometimes bad on tomato leaves. We took these under potato.

The fruits of tomato are occasionally bored by the caterpillar of *Heliothis obsoleta* but this is not a serious pest of tomato as a rule.

Euzophera perticella bores in the stems at times but only seems to have been noticed doing this in Bombay.

Euzophera perticella occurs in tomato stems in Surat.

Collection and destruction of attacked stems is the only thing to do.

Sucking insects on tomato include Mites and Mealy-bugs, the latter being generally *Pseudococcus* (*Dactylopius*) *virgatus* and being sometimes rather bad.

Mealy-bugs occur on tomato at Coimbatore.

CHILLIES (*Capsicum* spp.).

Chilli seedlings are sometimes attacked by *Brachytrypes portentosus* (*achatinus*) which we have already considered several times.

Brachytrypes was found cutting the young plants. It was bad at Dacca.

The leaves are eaten by *Monolepta signata* and *Laphygma exigua* but these are not important pests of this plant.

Boring in the stem one finds *Euzophera perticella* [see under brinjal] but it is not serious as a pest of chillies.

The fruits of chillies are occasionally attacked by fruit-flies and *Chætodacus ferrugineus dorsalis* was bred from *Capsicum frutescens* at Mandalay and from American chillies at Maymyo. This fly, however, has not been noticed as a pest.

At Nagpur chilli fruits are malformed by a Chalcidid which causes a gall. The damage done is considerable.

We do not know about that and would like to see it if it occurs again.

Sucking insects on chilli plants include :—

Lygæus pandurus.

Jassids.

Aphids.

Thrips.

Lygæus pandurus ["South Indian Insects," p. 481, fig. 365] occurs commonly on the plants but is not known to be a pest.

Jassids sometimes occur in numbers and do some damage, but we do not know the species concerned. They might be collected in bag or hand-nets.

Jassids are found on chillies in Berar.

Aphids and Thrips also occur but are very minor pests as a rule.

The roots are attacked by termites which sometimes do a good deal of damage. Only general control methods seem to be applicable.

HERSE CONVOLVULI

Herse convolvuli, Linn.

Fig. 1. Young caterpillars on leaves;
Fig. 2. A nearly full-grown caterpillar;
Fig. 3. Pupa in its underground chamber;
Fig. 4. Moth in repose;
Fig. 5. Moth with wings outspread.

SWEET POTATO (*Ipomœa batatas*).

The leaves of Sweet Potato are attacked by a good many insects but few of these are of any real importance. We find :— **Mr. Fletcher.**

Euchromia polymena.
Diacrisia obliqua.
Estigmene lactinea.
Prodenia litura.
Catephia inquieta.
Herse convolvuli.
Aspidomorpha miliaris.
,, *indica.*
Pilemostoma trilineata.
Metriona varians.
,, *circumdata.*
Coptocycla sp.
Cassid.
Oncocephala tuberculata.
Blosyrus asellus.
Myllocerus sabulosus.

Euchromia polymena has been found in Travancore as an occasional minor pest, as related in Entomological Note 61 in Bulletin 59.

Diacrisia obliqua occasionally occurs in districts where it is common. There is nothing special to say about it.

Estigmene lactinea occasionally occurs but is scarcely a pest.

Prodenia litura occasionally occurs on sweet potato but is of little importance as a pest.

Catephia inquieta has been found in small numbers on the leaves and is sporadically a minor pest in North Bihar. It has also been reared at Pusa on young sugarcane. We have also moths from Myingyan, in Upper Burma, from Coimbatore and Siruguppa (Bellary District).

Herse convolvuli is common and may be looked on as a minor pest, although it does not do much damage as a rule. The caterpillars may be hand-picked.

Aspidomorpha miliaris ["South Indian Insects," pp. 316-317, fig. 168] has a wide distribution in South-Easten Asia, having been recorded, from the Malay Peninsula, Philippines, Sunda Islands, New Guinea India, Yunnan and Tonkin. It is common throughout India and does a little damage at times by the larvæ feeding on the leaves, but it is scarcely a pest. It also breeds on wild species of *Ipomœa*. *Cassidocida aspidomorphæ*, Crawf., was reared from larvæ of *A. miliaris* at Bangalore.

Aspidomorpha indica seems to be widely distributed throughout India and Burma and has been reared on sweet potato at Moulmein and Pusa. It is scarcely a pest.

Pilemostoma trilineata we have from Tatkon (Burma), Lebong, Masuri, Chapra and Pusa. At Tatkon it was found on sweet potato and has been bred on this at Pusa. It is an occasional minor pest.

Metriona varians has been reared at Pusa on sweet potato and has also been found on *Ipomœa* sp. at Bulsar (Bombay). It is scarcely a pest.

Metriona circumdata has been reared on sweet potato at Pusa and we have it also from Chapra, Dacca and Surat. It is scarcely a pest.

Coptocycla sp. [" South Indian Insects," p. 317, fig. 169] occurs in Madras on sweet-potato but is scarcely a pest.

Another Cassid, unidentified as yet, was found on sweet potato at Moulmein.

Oncocephala tuberculata (Hispinæ) has been reared on sweet potato at Pusa and Coimbatore and we have it also from Bulsar (Bombay). It is not a pest.

Blosyrus asellus [Marshall, *Fauna of India, Curculionidæ*, I, 33] has been found at Pusa in small numbers on sweet potato, but is not a pest.

Myllocerus sabulosus [*l.c.*, p. 336] has also been found on sweet potato at Pusa but seems to be a mere casual visitor.

The stems of sweet potato are attacked by :—

Gonocephalum sp.
Omphisa anastomosalis.
Cylas formicarius.

A small species of *Gonocephalum* was found at Moulmein in September 1914 on the soil around sweet potato plants whose stems were found dead or dying, evidently as the result of some insect attack. The beetles were not actually noticed to eat the stems but the circumstances were decidedly suspicious.

Omphisa anastomosalis is included in " South Indian Insects," pp. 439-440, fig. 316, as a potential pest of sweet potato. It is common in India, the larva boring in stems of wild *Ipomœa*, but has not yet actually been found on sweet potato. I expect, however, that it will occur.

Cylas formicarius bores in the shoots but we will take it under tubers.

The tubers of sweet potato are attacked by :—

Cylas formicarius.
Metasia coniotalis.

Cylas formicarius [" South Indian Insects," pp. 334-335, tab. 12] is common throughout most parts of India and we have it from Peradeniya (Ceylon), Coimbatore, Manjri (Bombay), Poona, Surat, Damoh (Central Provinces), and Pusa, but we have no examples from Burma, Assam or the United Provinces or northwards of that. Outside of India it is known from the Seychelles, Madagascar, Java, Philippines, Bouru, Hawaii, China, North Australia, Southern United States, Antilles and Guiana. It is probably an endemic Indian species which has been spread artificially with sweet potato tubers.

So far as we are concerned, it is by far the worst pest of sweet potato and does very serious damage. Control is very difficult, one point about it being that the attack is often not noticeable until the damage has been done and the beetles are seen emerged and resting on the leaves. The beetles are attracted to light and some may be caught by light-traps but this is not effective as a control. Some beetles may also be caught in hand-nets or bag-nets swept over the foliage, but this again is not effective and, by the time that large numbers of beetles are caught in this way, it generally means that they have emerged from the tubers and that the damage has been done. The planting of deep-rooting varieties has also been suggested, but the eggs may be laid in the stems in which case the grubs are able to bore down into the tubers even when these are well below the ground. We do not know of any immune varieties of sweet potato. The best thing to do seems to be to keep a sharp look-out for the appearance of the first adult beetles in the foliage and to harvest the crop as soon as possible thereafter. When the crop is dug, infested tubers should not be thrown away, as is often done, but should be boiled and, if not too badly infested, may be fed to cattle. Probably it feeds also on wild species of *Ipomœa* but we have no records of such foodplants; if this is the case, such wild *Ipomœa* should be destroyed as far as possible in areas where sweet potato is grown.

Mr. Ghosh. By harvesting early, it has been found that damage is reduced, and, indeed, practically avoided.

Mr. Fletcher. *Metasia coniotalis* was found as a pest at Pusa in March 1907, the larvæ boring into the tubers below-ground. It has not since been noted to do damage although moths were caught in July 1910 and March 1915. This species is figured in " Indian Insect Life," tab. 52, figs. 1-4. It has been recorded from Tibet, Kashmir, Simla, Ferozepur and Pusa, but is apparently not a common insect as a rule.

Sucking insects found on sweet potato include :—

Graptostethus servus.
Halticus minutus.

Graptostethus servus ["South Indian Insects," p. 482, fig. 366] is common on sweet potato throughout India but is probably not a pest. It sometimes occurs in numbers and may be collected in nets.

Halticus minutus is a small Capsid bug, in appearance very similar to a Flea-beetle. When at Moulmein in September 1914 I found this in large numbers on sweet potato, and it was undoubtedly a pest, the leaves being spotted with punctures. It is probably common in most districts but that is the only occasion on which it seems to have been noticed in any numbers. It could be collected in hand-nets if sufficiently abundant.

JERUSALEM ARTICHOKE (*Helianthus tuberosus*).

Artichoke is nearly allied to Sunflower which we took under oil-seeds. The leaves are eaten by :—

Diacrisia obliqua.
Pachnephorus bretinghami.

Diacrisia obliqua occurs on artichoke much as it does on sunflower and the egg-masses and clusters of young larvæ should be picked off.

Pachnephorus bretinghami has been found at Pusa but is not much of a pest.

The roots of artichoke are sometimes attacked by *Dorylus orientalis*, which we have already considered several times and there is nothing special to say about it.

ASPARAGUS.

Asparagus seems to have few pests in India, but a Coreid bug, a species of *Brachytes*, was sent to us recently from Solan, near Simla, as attacking asparagus. In such cases the bugs could be collected by hand.

GINGER (*Zingiber officinale*).

Ginger is grown principally on the Malabar Coast and in Southern Burma. The leaves are attacked by *Udaspes folus* ["South Indian Insects," p. 420, fig. 295], which is sporadically serious as a pest, the caterpillar rolling the leaves : when in numbers the folded leaves containing the larvæ and pupæ are easily seen and the immature insects collected by hand.

The stems and rhizomes of ginger are also bored by the caterpillar of *Dichocrocis punctiferalis* [*l.c.*, p. 433, tab. 34]. It is not usually a serious pest on ginger and the only remedy is to destroy the attacked portions of the plants.

Calobata sp. has also been bred from decaying roots of ginger plants [" Indian Insect Life," p. 631, fig. 416] but it is doubtful whether it attacks healthy plants.

TURMERIC (*Curcuma longa*).

The leaves of turmeric are eaten by :—

Udaspes folus.
Diacrisia obliqua.

Udaspes folus [" South Indian Insects," p. 420, fig. 295] is a sporadically serious pest of turmeric, principally in Southern India. The greenish caterpillar folds the leaves and pupation takes place in the folded leaf. In 1912 at Coimbatore about thirty per cent. of the leaves were folded by these caterpillars in a crop of turmeric. The folded leaves are easily seen and the enclosed larvæ and pupæ may be collected by hand.

Diacrisia obliqua occasionally attacks turmeric, chiefly in Bengal and Bihar. The masses of young larvæ should be hand-picked before they have spread.

The stem of turmeric is bored by *Dichocrocis punctiferalis* [*l.c.*, p. 433, tab. 34], which also occurs in wild turmeric. The damage done is not serious as a rule and the only remedy is destruction of the attacked stems.

The rhizomes are attacked by :—

Calobata sp.
Aspidiotus hartii.
,, *curcumæ.*

Calobata sp. is common is turmeric rhizomes but is always found in rotting portions and it is not clear whether it actually does damage or is merely a decay-feeder.

Aspidiotus hartii was found on turmeric rhizomes at Poona in March 1914 and identified as *A. hartii* by Mr. Green in October 1915. *A. hartii* was described on yams in the West Indies and the Indian species is perhaps the next.

Aspidiotus curcumæ is an undescribed species, so named by Mr. Green from specimens found at Poona [*Bombay Nat. Hist. Soc. Journal*, XXIII., 135], the rhizomes being covered with this scale. It is possible that this is identical with the material formerly named as *A. hartii* by Mr. Green.

Stephanitis typicus [" South Indian Insects," pp. 484-485, fig. 369] is common on turmeric in Southern India and is at times a minor pest, the attacked leaves, where punctured, being spotted with yellow and

ultimately the whole leaf assuming an unhealthy yellow tinge. Control is hardly required on a field scale, but, if so, a soap spray would probably be effective.

Panchætothrips indicus is described in *Records Indian Museum* VII, pp. 257-260, tab., from examples collected many years ago in Southern India, where it was stated to have damaged turmeric. It does not seem to have been noticed of recent years. This is the insect referred to as *Sutta thegulu* in *Indian Museum Notes*, Vol. I, p. 109.

AMARANTHUS (*Amarantus* spp.)

The leaves of Amaranthus are eaten by :—

Laphygma exigua.
Hymenia fascialis.
Eretmocera impactella.
Hypomeces squamosus.
Atractomorpha crenulata.

Laphygma exigua [" South Indian Insects," pp. 378-379, fig. 240] occurs commonly on Amaranthus but is not much of a pest.

Hymenia fascialis [*l.c.* pp. 431-432, fig 307] is common throughout India, Burma and Ceylon. We have examples reared on Amaranthus at Pusa, Cuttack, Surat, and Trivandrum ; at Coimbatore on *Trianthyna monogyna* and Silver Beet ; at Pusa on mangold wurzel leaves, on *mung*, on *Coleus*, and on *Celosia cristata*, at Poona on beet, and at Mandalay on White Beet. It also feeds on *Alternanthera*. It is a minor pest on Amaranthus, occasionally doing serious damage in gardens.

Eretmocera impactella [*l.c.*, p. 461, fig. 337] occurs on the topshoots which are webbed up by the caterpillar. In Madras it has not been noted to do damage, but in Bihar plants, especially single plants, are sometimes badly webbed up and eaten back. The webbed tops should be destroyed.

Hypomeces squamosus [Marshall, *Fauna of India, Curculionidæ* I. 116-117, fig. 39] was found on Amaranthus at Mandalay but we do not know how far it is a pest. It does not seem to occur within our limits except in Burma.

Atractomorpha crenulata eats the leaves but is not serious as a pest. We took this under tobacco. The grasshoppers may be collected by hand.

The stems of Amaranthus are bored by *Lixus brachyrrhinus*, which is described and figured in " South Indian Insects," pp. 331-332, fig. 189, and of which we have since issued a coloured plate showing the lifehistory. There is not much to add to the account already given. As a rule,

Lixus brachyrrhinus, Bohemann.

Fig. 1. An affected plant showing the characteristic swelling;
Fig. 2. The affected stem cut open to show the grub inside;
Fig. 3. Grub (magnified);
Fig. 4. Pupa (magnified);
Fig. 5. The adult beetle (magnified);
Figures in outline show the natural sizes.

Lixus brachyrrhinus.

several grubs are found in one stem, which swells up and assumes a characteristic gall-like appearance at the point of attack; this is brought out in figure 1 in the coloured plate. This weevil is a minor pest of cultivated forms of Amaranthus and systematic destruction of attacked plants is the only way to reduce damage. *Lixus brachyrrhinus* seems to be widely distributed throughout the Plains of India and Burma.

ONION (*Allium cepa*).

The leaves of onion are attacked by :—

Laphygma exigua.
Agrotis ypsilon.
Thrips.
Aphids.

The caterpillars of *Laphygma exigua* and *Agrotis ypsilon* feed on the leaves, hiding inside the tubular stalks, but are not common on onion and cannot be regarded as pests.

Thrips occur on the flowers and are sometimes bad in Madras. The species concerned is doubtful. A Thrips occurs in Ganjam, feeding on the leaves which become sickly and yellow; this is perhaps *Heliothrips indicus*, Bagnail.

Aphids also occur commonly on the stems and flowers but we do not know the species concerned and little damage seems to be done as a rule.

GARLIC (*Allium sativum*).

We know of no insect pests of garlic, which seems to be shunned by all self-respecting insects.

RUMEX VESICARIUS.

Rumex vesicarius is a vegetable grown extensively around Poona for the Bombay and Poona markets. In October 1916 Mr. Ramrao Kasergode sent us from Poona some insects damaging this crop and they proved to be *Sterrha sacraria* and *Hippotion celerio*. *Sterrha sacraria* occurs commonly throughout the Plains of India but we have never before considered it as a pest; on the present occasion the caterpillars occurred in large numbers and did considerable damage. *Hippotion celerio* larvæ were also found in smaller numbers.

YAM (*Dioscorea* spp.)

The only insect noted on yam is *Acrolepia manganeutis* [see Entomological Note 90, fig. 17, in Bulletin 59] and in that case it was reared from stored yams. We do not know of any pests of growing yams.

COLOCASIA ANTIQUORUM.

Colocasia has no serious pests. The leaves are eaten by *Monolepta signata*, and the caterpillars of *Pericallia ricini*, *Prodenia litura*, and *Rhyncolaba acteus*.

ELEPHANT'S FOOT (*Amorphophallus campanulatus*).

The leaves of Elephant's Foot are eaten by the caterpillar of *Theretra gnoma*, which has been reared on this at Pusa and Poona. At Pusa it is not looked on as a pest, but it is stated to do considerable damage at Poona.

ARROW-ROOT (*Maranta arundinacea*).

The young leaves of arrow-root are eaten by *Atractomorpha crenulata*, which we dealt with under tobacco. Otherwise we know of no pests.

CARROT (*Daucus carota*).

The leaves of carrot are eaten by the caterpillar of *Plusia orichalcea*, but this is not a pest. *Agonoscelis nubila* ["South Indian Insects," pp. 472-473, fig. 351] is also fairly common on carrot in Madras, but is not a pest. *Dorylus orientalis* was found attacking the tuberous roots at Pusa last year but this is decidedly unusual. Carrot seems free of any serious insect pests.

CASSAVA (*Manihot utilissima*).

We know of no insect pest of Cassava. Melolonthid grubs occur as pests in Java, and probably in India also but have not been noticed.

CORIANDER (*Coriandrum sativum*).

Aphids are abundant on coriander at Pusa but we do not know the species concerned.

FENUGREEK (*Trigonella fœnum-græcum*).

[*Methi*—Hind.]

We have no insect pests on our list under Fenugreek.

In North Gujarat Aphids occur on it.

CELERY (*Apium graveolens*).

Caterpillars of *Plusia orichalcea* eat the leaves of celery but are scarcely reckoned as pests as a rule. They may be hand-picked when they occur.

MORINGA (*Moringa pterygosperma*).

The leaves of Moringa are eaten by the caterpillars of—

Pericallia ricini.
Eupterote mollifera.
Noorda blitealis.

Pericallia ricini ["South Indian Insects," pp. 370-371, fig. 232] occurs, chiefly in Madras, as a minor pest. The larvæ may be hand-picked.

Eupterote mollifera ["South Indian Insects," pp. 404-405, fig. 275] is a specific pest of *Moringa* in Madras, occurring sporadically in enormous numbers and defoliating the trees attacked. The caterpillars usually rest in the daytime in a mass on the tree-trunk and may then be burnt off with a torch, care being taken not to handle them or even to approach nearer than is necessary the trees affected, as the larval hairs are highly urticative. *Eupterote mollifera* has also been noted in Ceylon as a pest of *Erythrina*.

Noorda blitealis [*l.c.*, pp. 441-442, fig. 318] occurs throughout the Plains of India, Burma and Ceylon as a very minor pest of *Moringa*, the caterpillar attacking the leaves, shoots and small pods. We have it from Hagari (Bellary District), on *Moringa*, from Nagpur on "Munga" (the Santal name for *Moringa*), and we have moths also from Pusa and Myingyan (Upper Burma). The caterpillar folds or joins the leaves and sometimes does considerable damage by feeding on the green substance of the leaves.

In the Central Provinces the caterpillar is found on the pods. **Mr. Khare.**

Cyclopelta siccifolia ["South Indian Insects," p. 476, fig. 357] sometimes occurs on *Moringa* also, although this foodplant is not included in my book. In the Southern parts of Bombay it is sometimes a bad pest during the Rains. The bugs may be collected by hand. **Mr. Fletcher.**

At Nagpur *Batocera rubus* bores in the stems of *Moringa*. **Mr. Khare.**

PEPPER (*Piper nigrum*).

Pepper is grown chiefly in the Hill Districts of Southern India. In Coffee Districts it is often grown up the shade-trees amongst the Coffee. The leaves are attacked occasionally by caterpillars of *Parasa lepida* but this is of little account as a regular pest, and the worst pests are Scale-insects amongst which we know :— **Mr. Fletcher.**

Mytilaspis piperis.
Hemichionaspis aspidistræ.
Aspidiotus destructor.
Lecanium marsupiale.

Mytilaspis piperis ["South Indian Insects," p. 519, fig. 409] occurs in the Wynaad and is a local minor pest as a rule, occasionally destructive within a limited area, a few adjacent plants being sometimes badly affected. In such a case, spraying or destruction of badly affected plants is indicated to check spread.

Hemichionaspis aspidistræ is very widely distributed, having been recorded from France, England, India, Ceylon, Formosa, Japan, Australia, Brazil, and the United States on a variety of plants, including pepper, orange, mango, fig, *Acacia* and *Areca*. It occurs on pepper in the Wynaad and on the Malabar Coast, but we do not know whether it is serious as a pest.

Aspidiotus destructor [*l.c.*, p. 518, fig. 408] occurs throughout Southern India and is an occasional pest of pepper. [See under Coconut.]

Lecanium marsupiale [*l.c.*, p. 516, fig. 405] is a very large Scale found on pepper in the Wynaad. I have no more to add beyond what has been published already.

The shoots of pepper are bored by the larva of *Laspeyresia hemidoxa*, which was reared at Taliparamba, but we do not know it as a pest.

At Taliparamba Halticine Chrysomelid larvæ were found boring the berries badly. This insect has not been identified.

Betel Leaf (*Piper betle*).

Betel leaves seem to be eaten by few insect pests. *Popillia chlorion* was found at Coimbatore, and *Capua invalidana* (Tortricidæ) was bred at Nagpur in December 1915 from caterpillars on betel leaves, but neither insect has been noted as a pest.

Sucking insects, however, are of more importance as pests and amongst these we have :—

Cyclopelta siccifolia.
Disphinctus politus.
Aleurocanthus (*Aleyrodes*) *nubilans.*
Coccids.

Cyclopelta siccifolia ["South Indian Insects," p. 476, fig. 357] is common in most betel-leaf-growing districts and is a minor pest, probably worse in districts where *Erythrina* is used as a support for the betel vines. The bugs are sluggish and tend to cluster together and so are easily collected by hand.

Disphinctus politus [*l.c.*, p. 489, fig. 375] is widely distributed throughout India, Burma and Ceylon and has been noted as a pest of betel chiefly in Madras, Kanara and Bassein (Bombay), the leaves punctured by this bug withering and being useless for the market. The life-history

is briefly described in "South Indian Insects," and there is little to add. Distant gives several other foodplants in Ceylon, but it has not been noted on these in India. As regards control, the adult bugs may be caught in hand-nets, but they are active and not easy to catch. The immature stages may be sprayed with a soap solution.

Aleurocanthus (*Aleyrodes*) *nubilans* [*Indian Museum Notes*, V, 36, t. 5, figs. 7-9] was described from Backerganj and was reported to be doing considerable damage to "betel leaves", but it is rather doubtful whether the host-plant was betel vine or betel-palms. Anyway, it does not seem to have been noticed since.

Coccids occasionally occur on betel-leaves but we seem to have no definite records and scales are not serious as pests of betel-vines.

A mealy-bug [? *Pseudococcus* sp.] is found a good deal on betel leaves at Raipur. **Mr. Ratiram.**

In the Sangamnar Taluq of the Ahmednagar District, earthworms occurred in large numbers in a betel garden on one occasion. It was supposed that the earthworms had eaten up all the nutritious food from the soil and left it very poor. Ammonium Sulphate, saltpetre, and common salt were tried, but no effect was noticed. **Mr. Jhaveri.**

Earthworms were also sent in on several occasions when I was at Coimbatore. They were present in very large numbers in some betel gardens there and were supposed to be doing damage, but the amount of damage done seemed rather doubtful. The worms were probably in large numbers because the soil in these gardens is kept rich and damp and ordinary enemies of worms are excluded. They may impoverish the soil, when present in such excessive numbers, but that is a point which requires further investigation. The usual idea about earthworms is that they do good. In the present case, no direct damage to the plants could be made out. If damage is actually done, it could probably be met by manuring. **Mr. Fletcher**

ANISEED (*Pimpinella anisum*).

The only insect pests noted on Aniseed are *Agonoscelis nubila* ["South Indian Insects," pp. 472-173, fig. 351] and Aphids. Both are minor pests and control has not been applied.

MELONS AND PUMPKINS (*Cucurbita*, *Cucumis* and *Citrullus* spp.).

Various species of melons and pumpkins are cultivated and as regards pests it is not necessary or practicable to distinguish between them.

The flowers are attacked by various Meloid beetles, which may be caught by hand or in hand-nets.

The leaves are eaten by :—

Epilachna 28-punctata.
,, *12-stigma.*
Aulacophora abdominalis (*foveicollis*).
,, *atripennis* (*excavata*).
,, *stevensi.*
Pericallia ricini.
Plusia peponis (*agramma*).
Margaronia (*Glyphodes*) *indica.*
Sphenarches caffer.

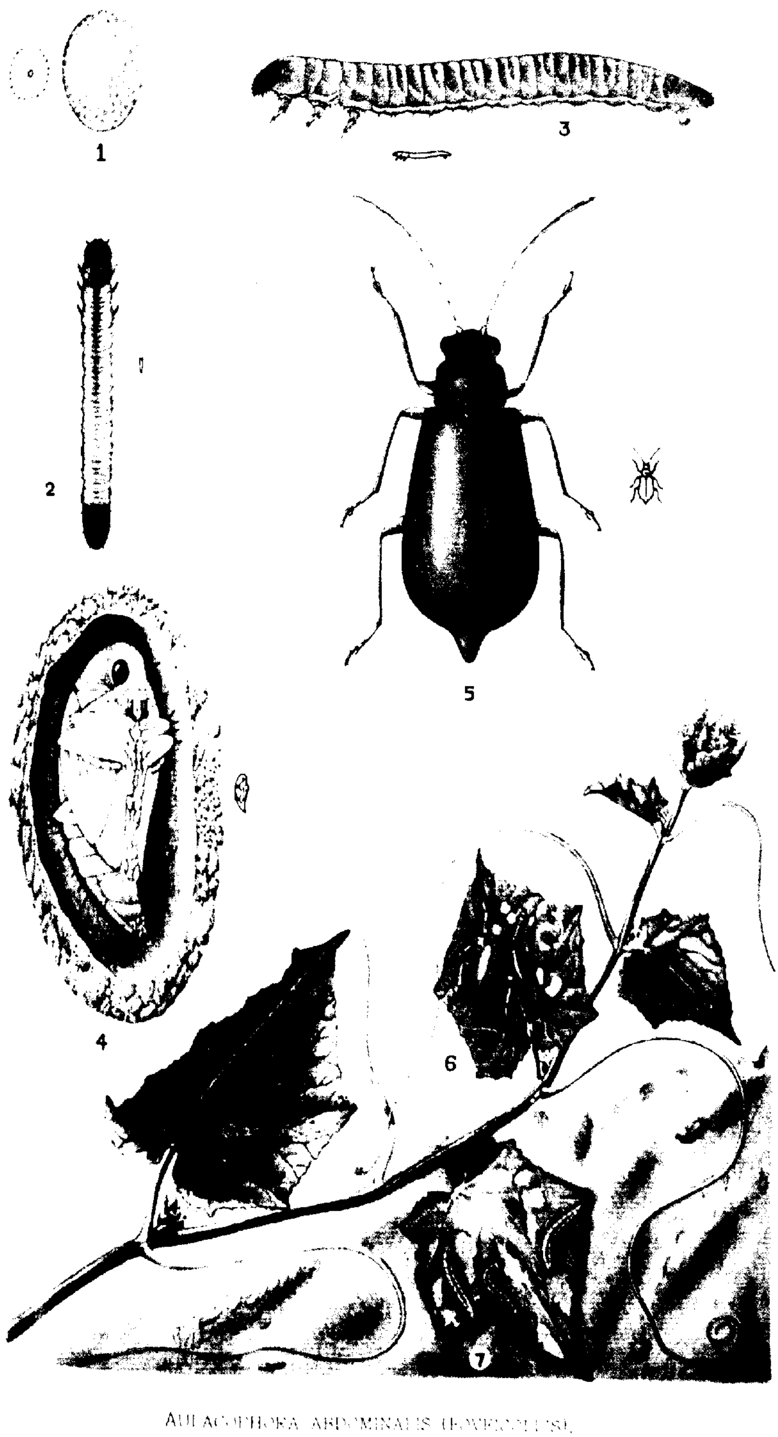
Epilachna 28-punctata was discussed under brinjal. It is common on all pumpkins, gourds and cucurbitaceous plants generally throughout India and Burma and is always a minor pest occasionally doing a good deal of damage, the larvæ and adult beetles both feeding on the leaves.

Epilachna dodecastigma [" South Indian Insects," p. 292, tab. 6] is equally common and widely distributed and with identical habits. In fact, the larvæ of these two species have not been differentiated as yet. Collection by hand of the insects in all stages, and in bad cases spraying, will provide control.

Aulacophora abdominalis is described and figured in " South Indian Insects," p. 311, fig. 161, but the figures copied from Shiraki are not really of *A. abdominalis* but of an allied Japanese insect. We have since figured the complete lifehistory in a new coloured plate and I may remark that it took about five years to discover the mode of life of the early stages of this common insect. The eggs are laid in cracks and crevices in the soil and the larvæ live underground, feeding on or boring into roots, or on the surface of the ground feeding on fallen leaves. Pupation takes place in the soil in a regular cocoon. So far as leaves are concerned, it is practically only the adult beetle which attacks them ; occasionally a leaf lying on the ground may be eaten by the larvæ, but the damage so done is insignificant. Young plants are most badly attacked and the damage to grown plants is not great as a rule. As regards the adult beetles, control is attained by (1) sprinkling the leaves with kerosinized ashes, (2) catching the beetles in hand-nets, (3) if necessary, spraying with a stomach-poison. The larva is unimportant as a pest of leaves but is sometimes serious when it bores into the roots, especially in the case of young plants. In such cases, little can be done beyond watering with a repellent and destroying attacked plants, but the reduction in numbers of adults will lead to a corresponding reduction in damage done by grubs. It is in the adult stage that this insect is most easily checked.

Aulacophora abdominalis, Fb. (*foveicollis*, Kust.)

Fig. 1 shows a single egg (magnified);
Figs. 2 and 3 show young and full-grown grubs (magnified);
Fig. 7 shows full-grown grubs, natural size, feeding on a fallen decaying leaf;
Fig. 4 is a pupa in the pupal cell (magnified);
Fig. 5 is the adult beetle (magnified); and
Fig. 6 a beetle, natural size, feeding on a cucumber leaf.
Figures in outline show the natural sizes.



AULACOPHORA ABDOMINALIS (FABRICIUS).

MARGARONIA (GLYPHODES) INDICA.

Margaronia (Glyphodes) indica, Saund.

Fig. 1, caterpillar on leaf (natural size).
Figs. 2 and 3, caterpillar, enlarged, back and side view.
Fig. 4, cocoon.
Fig. 5, pupa.
Figs. 6 and 7, moth, natural size and enlarged.

Aulacophora atripennis [" South Indian Insects," p. 312, fig. 162] is also common practically throughout the Plains of India and Burma and is common on all cucurbitaceous plants, although it is usually less serious as a pest than *A. abdominalis*. The lifehistory is not known definitely but it is probably quite similar, as are also damage done and methods for control.

Aulacophora stevensi [*l.c.*, pp. 312-313, fig. 163] is common in Madras and Burma, but its distribution is more limited than that of the last two species. The lifehistory is probably much the same as in *A. abdominalis* and the nature of damage and means of control are the same, but *A. stevensi* often eats flowers of gourds also.

Pericallia ricini [*l.c.*, pp. 370-371, fig. 232] is occasionally found on cucurbits but is not common as a rule. When it occurs in gardens, however, it may do damage. The young larvæ should be handpicked before they have scattered.

Plusia peponis (*agramma*) [*l.c.*, p. 394, fig. 261] occurs throughout India and in Ceylon and the Andamans and is a minor pest of gourds. We have it from Pusa on bottle-gourd and from Coimbatore on snake-gourd. The caterpillars and cocoons may be collected by hand.

Margaronia (*Glyphodes*) *indica* is described and figured in " South Indian Insects," pp. 135-136, fig. 312, and we have since issued a coloured plate showing the complete lifehistory. It is abundant throughout India, Burma and Ceylon and is a minor pest of pumpkins and cucurbits generally. The egg is laid on a leaf as a rule. The caterpillar usually feeds on the leaves, but sometimes the fruits are attacked also. As shown in the coloured plate, the caterpillar generally folds up a leaf and lives inside the folded portion, eating away patches of the leaf-surface. Pupation takes place in a thin white silken cocoon formed inside folded leaves or occasionally in holes bored in the fruit. The caterpillar is often found on the under-surfaces of leaves. The damage done is usually small and control is not required but, if it has to be done, the caterpillars and cocoons may be collected by hand from the folded leaves.

The stems of pumpkins are bored by :—

Apomecyna pertigera.
,, *perotteti.*
,, *histrio.*

Apomecyna pertigera [" South Indian Insects ", p. 327, tab. 11] is widely distributed in India and Burma. The Pusa Collection contains examples from Coimbatore, Jorhat, Chapra, Pusa, and Mandalay. It is a minor pest of pumpkins and other cucurbitaceous plants, the larva

boring in the stem and the adult eating into young fruits. It has been bred at Pusa on pumpkin, cucumber fruit and bottle-gourd, and at Mandalay on pumpkin. Destruction of affected stems and collection of beetles when seen on the plants are the only control-measures.

Apomecyna perotteti is apparently confined to Southern India. We have examples from Kanara, Madura and Pollibetta. The lifehistory is not known but is likely to be the same as that of *A. pertigera* and at Pollibetta I collected specimens around cucurbits.

Apomecyna histrio we seem to have only from North Bihar, our specimens being from Chapra, Pusa and Laheria Serai. It has been reared at Pusa from larvæ boring stems of *Tinospora cordifolia* [*gurrach*-Hind.] but probably attacks cucurbits also.

The sucking insects found on pumpkins include :—

Aspongopus janus.
,, *brunneus.*
Aphids.

Aspongopus janus ["South Indian Insects," pp. 476-477, fig. 358] is sporadically common on pumpkins, when the bugs may be hand-picked.

Aspongopus brunneus occurs in the same way as *A. janus* but is less often noticed.

Aphids are sometimes bad on pumpkins, the whole leaves being covered with sticky excretion. In garden plots, spraying may be done if required but in field plots little is done as a rule beyond leaving the natural enemies to check the pest.

The roots are attacked by the grubs of *Aulacophora abdominalis* and perhaps by those of the other species of *Aulacophora*, which we took just now.

The fruits are attacked by :—

Chætodacus cucurbitæ.
Dacus brevistylus.
Myiopardalis pardalina.
Aulacophora abdominalis.
Acythopeus citrulli.

Chætodacus cucurbitæ was partially considered when we discussed the general subject of Fruit-flies [see under Peach]. It is widely distributed throughout India and Burma and does very considerable damage to cucurbits of practically all kinds. It has been reared from fruits of *Cucurbita pepo*, *C. melo*, *Trichosanthes dioica*, *T. cucumerina*, *Cucumis*, *Momordica charantia*, *Luffa ægyptiaca* and various other cucurbits. The lifehistory is briefly given in "South Indian Insects," pp. 354-355,.

tab. 16, but it may be as well to add that the grubs are sometimes found boring in stems as well as in fruits.

As regards control, we discussed that under Peach, but a special line of control with parasites of this species has been taken up in Hawaii, as I told you the other day. In India *Chætodacus cucurbitæ* appears to be parasitized to a remarkably small extent but, from larvæ collected at Pusa in fruits of *Momordica charantia*, we reared about fifteen per cent. of a small Braconid parasite which has been described by Professor Silvestri under the name *Opius fletcheri* [*Boll. Lab. Zool. Portici* XI, pp. 163-164, fig. 2]. *Syntomosphyrum indicum*, Silv. [*l. c.*, IV, 232-344] was also found at Bangalore by Compere but is apparently not attached especially to *Ch. cucurbitæ*.

I told you the other day about the visit of Mr. Fullaway to India in 1915 especially to search for parasites of *Ch. cucurbitæ* with the purpose of introducing them into Hawaii. A short account of his journey is given in the *Hawaiian Forester and Agriculturist* for August 1916. Mr. Fullaway was in Bangalore from 17th November to 23rd December 1915 and in that period he reared about 10,000 specimens of *Ch. cucurbitæ*, out of which *Opius fletcheri* came abundantly as well as a small lot of *Spalangia*, but *Syntomosphyrum indicum* could not be rediscovered. After staying in Singapore and Manila, Mr. Fullaway eventually returned to Honolulu on 10th May 1916 with a small lot of living examples of this *Opius* and this has been bred successfully and liberated in Hawaii, as is shown by the fact that during the five months July to November 1916 no less than 9,173 females and 5,361 males of *O. fletcheri* were reared in the insectary and of these numbers most were liberated. This attempt to procure parasites, therefore, was quite successful. Why *Ch. cucurbitæ* is not controlled more thoroughly by parasites in India is not apparent. We have not reared any hyperparasites, so the scarcity of the parasite is not likely to be due to this cause; nor is it likely to be due to scarcity of food, as *Ch. cucurbitæ* is sufficiently abundant— in fact, only too abundant— everywhere. Yet, out of thousands of examples of *Ch. cucurbitæ* reared at Pusa we have found it decidedly the exception to secure material parasitized to any appreciable extent. It will be interesting and useful if the Provincial Entomological Staffs will collect *Ch. cucurbitæ* grubs and pupæ in numbers and either send them to Pusa or breed them out, to see what parasites there are and in what proportions they are found.

Dacus brevistylus is recorded from Madras, where it has been reared in melons at Coimbatore and Cuddapah and in water-melon at Hagari. It is probably more widely distributed, but overlooked.

Myiopardalis pardalina is well-known as attacking melons in Baluchistan and there was an article by Mr. Cleghorn about this in the *Agricultural Journal of India* about three years ago. We have since found this species at Pusa and it is probably fairly widely distributed.

Aulacophora abdominalis grubs have also been found to attack melon fruits at Jullundur, boring in the fruits in the portion in contact with the ground. This form of damage was first noted in 1915 and was serious, more than that caused by Fruitfly. We considered this insect just now and there is no more to add. Probably a small handful of kerosinized ashes under the fruits would ward off attack.

Acythopeus citrulli was recently described by Dr. Marshall from examples reared from water-melon at Hagari, in the Bellary District. This weevil was found actually doing damage to a few fruits, but its status as a pest is doubtful.

BOTTLE-GOURD (*Lagenaria vulgaris*).

[*Kaddu*—Hind.]

The pests of Bottle-gourd are practically the same as those of melons and pumpkins, but in addition we get :—

Plusia chalcytes.
Sphenarches caffer.

Plusia chalcytes has been reared on bottle-gourd at Pusa but is scarcely a pest.

Sphenarches caffer is briefly described and figured in "South Indian Insects," pp. 443-444, fig. 320, and we have since illustrated the life-history on a new coloured plate. The eggs are laid singly on leaves and the caterpillars eat holes in the leaves, on which, or on stems of the foodplant, they pupate when full-grown. This insect is a minor pest of bottle-gourd but has a very wide range of foodplants, having been reared on leaves of bottle-gourd, buds of *Luffa* sp., petals of *Hibiscus mutabilis*, flowers of *Cajanus indicus*, *Averrhoa bilimbi* flowers, *Biophytum sensitivum*, and various other plants. It is common throughout India, Burma and Ceylon and, outside of India, throughout Australia and Africa. As regards bottle-gourd, it is a very minor pest and remedial measures are rarely necessary.

Metacanthus pulchellus was sent in in March 1913 as damaging bottle-gourd plants at Baroda by puncturing young fruits. It is widely distributed in India but does not seem to be a serious pest as a rule.

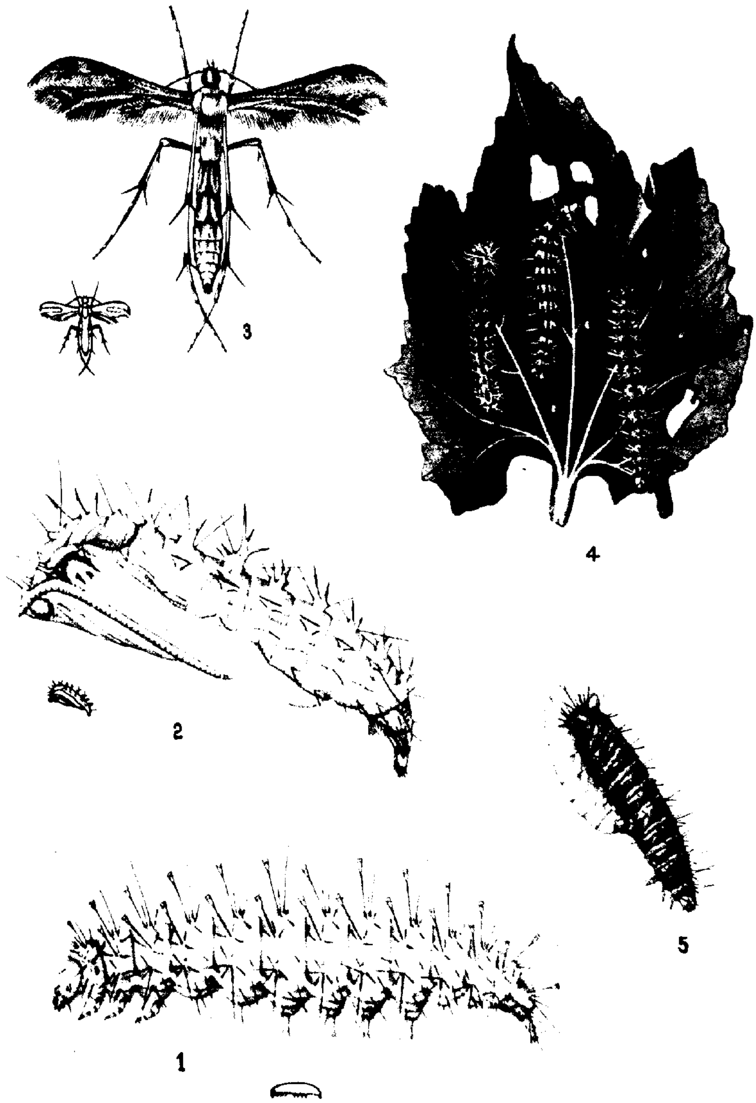
Sphenarches caffer, Zell.

Fig. 4, is a bottle-gourd leaf having on it 4 eggs, two caterpillars (one green and the other brown) and one pupa ;

Figs. 1, 2 and 3 show respectively the caterpillar, pupa and moth, all enlarged.

The caterpillars are parasitized by a small hymenopteron, figure 5 showing such a parasitized dead caterpillar from the body of which the parasite grub has just emerged.

Figures in outline show the natural sizes.



SPHENARCHES CAFFER.

On the other hand, we do not seem to get *Epilachna* on bottle-gourd.

The fruits of bottle-gourd support a fruitfly fauna distinct from that found in pumpkins. In bottle-gourd we get :—

Chætodacus zonatus.
" *diversus.*

Chætodacus zonatus was reared at Nagpur in August 1913 and *C. diversus* also at Nagpur in August 1913, in both cases on bottle-gourd.

SNAKE-GOURD (*Trichosanthes anguina*).

The insects found on snake-gourd are practically the same as those found on pumpkins, *e.g.*, *Epilachna* spp., *Aulacophora* spp., *Plusia peponis*, *Margaronia indica*, and Aphids.

Trichosanthes cucumerina.

T. cucumerina is a wild species of snake-gourd found throughout India, Burma and Ceylon. Its pests are much the same as those of the other cucurbits and include *Epilachna* spp., *Aulacophora stevensi* and *Chætodacus cucurbitæ*. In addition to these, at Tatkon, in Lower Burma, I found another fruitfly, recently named by Professor Bezzi as *Mellesis eumenoides*, and the curious bug *Leptoglossus membranaceus*, which is an occasional pest of cucurbits, as noted in Ceylon also by Mr. Green.

GOURD (*Luffa acutangula*).

The pests of gourd are similar to those of pumpkins and include Meloid beetles on the flowers, *Epilachna* spp. and *Aulacophora* spp. on the leaves, and *Apomecyna* boring in the stem. We also get *Riptortus pedestris* at times.

Mr. Fletcher. That brings us to the end of our review of the Insect Pests of Crops in India and we have only a very small amount of time left for the consideration of

INSECT PESTS OF STORED PRODUCTS.

but, unless anyone has any thing particular to say on this subject, we can take up this item to-day and run over it in a very brief manner. It is the less necessary to enter into it in any great detail because the available information has already been summarized in Chapter XVIII of "South Indian Insects" and that is practicably applicable to the whole of India. To the information given there I may add that *Corcyra cephalonica* should be added to the list of destructive species and is common in India and Burma in stored rice, and that *Rhizopertha dominica* has

been a bad pest of stored grain recently in Madras and has been controlled quite successfully by treatment with carbon bisulphide.

In Northern India work on stored wheat pests has also been done in the Punjab and an account of that has just been published by Messrs. Barnes and Grove, so that all the information to date on that subject is already available. I may add that I have had some reprints made separately of the entomological part of this Memoir and these reprints are available for use of the Entomological Staffs in the Provinces or elsewhere.

At Peshawar also, Mr. Robertson-Brown and myself are testing a local type of timber-built granary against the more usual type built of mud, but this experiment is not concluded.

Turning to our own work at Pusa, you will have seen by our Annual Reports that we have been carrying out various experiments on the protection of stored grain against insect attack. In 1915 we did these on a small scale, with one-pound lots of grain in glass jars; that series of experiments gave us some information and enabled us to reject many failures. In 1916 we repeated the more successful experiments on a larger scale, using gunny bags and earthen jars as containers for the grain; and this year we intend to try the methods, hitherto found successful, on a still larger scale. But, until we have thoroughly tested methods on a large scale, it is rather premature to say much about them. These experiments have been made in the Pusa Insectary, so I will ask Mr. Ghosh to give you a brief account of them so far as they have gone, but I must repeat that they are not yet completed, so that we are not prepared as yet to say that we are in a position to recommend the best preventive measures; and also, of course, it is possible that any measures found successful here may require modification under different climatic or other conditions.

For the last two years we have been carrying on experiments to endeavour to find out a successful method or methods of preserving grain in store against insect pests. We have included in our experiments

(1) pulses, by which I mean pulse seeds,
(2) rice, by which I mean husked rice,
(3) wheat.

Without going into details of the experiments I only give the results of those which have been found successful.

Pulses, in our experience here, have to be protected against *Bruchus chinensis* which does the principal and very serious damage in store. We have never found it affecting grain in field. It breeds continuously in store, the life-cycle ordinarily being three to four weeks.

It has been found that the small variety of pea, *Pisum arvense*, is not affected by this pest, though the larger varieties of peas, gram, Arhar (*Cajanus indicus*), Lentil, Khesari (*Lathyrus sativus*), Mung (*Phaseolus radiatus mungo*), Bora (*Vigna catjang*) and Bakla (*Vicia faba*) are all liable to serious damage.

In the present state of our experiments we recommend keeping the pulses covered with sand, coarse or fine, and they will remain safe.

The other pulse beetle of which we have experience is *Bruchus affinis* which affects only peas while still inside the pods in the field. This pest does not breed in store. That fact was mentioned while discussing the pests of peas. Damage can be prevented by fumigating the seeds with carbon bisulphide as soon as harvested or storing the seeds in air-tight vessels with naphthaline. Treatment with naphthaline is, however, unsuitable in the case of seeds required for consumption afterwards. The seeds to be sown if untreated should be thrown into water and only those which sink should be sown.

Rice should be mixed with dry powdered lime at the rate of 100 lb. rice and 2½ lb. lime and stored in any way one likes in gunny bags, jars or bins. It will remain free from infestation by pests.

Wheat. First of all various methods were tried with small lots of wheat—two to four lb.—in airtight glass jars, in gunny bags and in earthen pots, earthen pots and gunny bags being the two kinds of receptacles ordinarily used by people for storing small quantities. Many of the methods were rejected and those only which promised success were tried on a small storage scale next year. Many of the results which seemed probable on the first year's experiments were upset. But some important differences in the habits of the principal pests were clearly demonstrated. The principal pests here are (1) *Calandra oryzæ* and (2) *Rhizopertha dominica.* In the Punjab in addition to these two there is a species of *Trogoderma* but of this I have not got much experience.

Rhizopertha cannot breed where there is free access of air, but under the reverse conditions it is capable of doing much more damage than *Calandra.* Air and light retard *Calandra* and if one can take the trouble of exposing the grain to air and light at frequent intervals very little damage is done. But this is not practicable when large quantities have to be dealt with. This year we propose to try a method of outdoor storage under conditions which will make it impossible for *Rhizopertha* to breed and which will keep the grain exposed to the natural changes of climatic conditions. If this be found successful it will be applicable both to storage in bulk and in small quantities, and it will enable a man to make a profit of about 5 to 8 per cent. simply on the increase of the

weight of the grain in addition to profit due to rise in price if he sells his grain in October-November instead of in April-May. Of course I am talking of Pusa conditions.

At present we can only recommend storing in vessels with solid bottom and walls and open top with a layer of about four inches of dry fine (not coarse) sand. The difficulty is that the sand settles through the grain and exposes some of the grain especially near the walls. Precautions should be taken against this.

In reply to a question of the Bombay representative regarding efficacy of castor oil treatment commonly practised in Gujarāt, it was said that castor oil retarded germination to a great extent and that *mohwa*, coconut, mustard and groundnut oils were better than castor oil but none of the oils rendered wheat immune. Besides that, oil made the grain very unsightly.

I am afraid that it is getting late and we cannot go on much longer to-day and, as this is the last day, we must now terminate this Meeting. But, before we do so, I should like to say a few words :—

Firstly, as I told you last week in my Opening Speech, we, the Staff of the Entomological Section at Pusa, have been very glad to see you, the Provincial Entomological Staffs and others interested, at this Meeting. We have gone through all these Crops together and reviewed the pests of each and have given one another all the information available regarding these pests and their control, and I am quite sure that this mutual interchange and discussion of experiences has been of great benefit and interest to all of us. It is not only important for each of us to know what others have discovered and are doing but it is equally, perhaps more, important to find out what are some of the things that we do not know and which require investigation. The benefits of mutual association and discussion of knowledge already attained are obvious advantages of a Meeting of this kind, but it has seemed to me, both at our Meeting here two years ago and during the course of this present Meeting, that the dragging into prominence of the innumerable gaps in our knowledge of Indian Insects is an even more valuable result of these Meetings.

Secondly, in order to render the results of these Meetings of permanent value, not only to ourselves who attended but also to others interested, it is necessary to publish a Report as full as possible. Mr. G. R. Dutt has been taking notes during the present Meeting and later on I hope to go over these and make out for publication as complete a Report as we can.

Thirdly, regarding our next Meeting, I cannot speak with authority but I believe that I am not giving away any secret in saying that the

idea of these Sectional Meetings has appealed to Government as an eminently practical idea, and we expect that they will become recurring functions. We have already had two Entomological Meetings and I am sure that I have the sense of this Meeting behind me when I say that they have both been highly successful Meetings and should be continued in the future and repeated at similar intervals—probably every two years.

Fourthly, assuming that we shall hold another Entomological Meeting in two or three years time, there are a few points which you might think over in the interval. Two years ago we went over the List of Crop Pests in systematic order, taking each insect at a time and going over its distribution and foodplants and so on ; this time we have gone over the Crops and taken insect pests crop by crop. In both cases we have found that a period of a week or so is insufficient to do this with proper thoroughness, in spite of having afternoon sessions. I think that the next Meeting, if we have one, should last for at least a fortnight, holding sessions in the mornings and leaving the afternoons free for consultation of records and collections, identification of specimens and so on, by the visitors. The Proceedings might also be simplified to some extent by the submission of written papers on special subjects ; that would reduce the note-taking to a great extent. However, you have most of you attended two of these Meetings now, and will come to the next one with more settled ideas of what is wanted. You might think over these and any other points that occur to you and let us know about them in good time for the next Meeting.

Mr. Ramakrishna Ayyar. Before the Meeting is closed I should like, on behalf of the visitors to Pusa, to express our thanks to Mr. Fletcher and the members of the Entomological Staff at Pusa for the great trouble they have taken in making this Entomological Meeting a success and in affording every assistance and help in the way of information in every way to us visitors to Pusa. We shall go away not only equipped with the latest information on our subject but, as Mr. Fletcher has just pointed out, with some ideas, which will be new to many of us, regarding points about which we require fuller information. We hope that this Meeting of Entomological workers in India will become a permanent feature of our programmes. The idea of holding a Meeting of this sort was initiated and put into practice by the Imperial Entomologist two years ago. We Entomologists have been the pioneers in the institution of these Sectional Meetings and, if the idea is extended to other branches of the Agricultural Service, we shall have the satisfaction of knowing that, and, when workers in other branches of Agriculture are holding

their first Meeting, we shall be holding the third of our Entomological Meetings.

I am glad to hear that our efforts have met with appreciation. As I have already said several times, it is a matter of equal satisfaction to us to see you at Pusa and to give you all the help we can and to interchange mutual experiences.

I now declare this Meeting closed.

[End of proceedings.]

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All scientific names of insects and plants are indexed under both specific and generic names, but page references are only given under the latter.

All names *in italics* are treated as Synonyms.

B.

C.

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